

**A REDUCED-RISK PEST MANAGEMENT
PROGRAM FOR WALNUTS**

CONTRACT NUMBER: 98-07 0329

Final Report Year 2: January 1, 2000–December 31, 2000

SUBMITTED BY:

**WALNUT MARKETING BOARD
DENNIS A. BALINT, EXECUTIVE DIRECTOR
1540 RIVER PARK DRIVE, SUITE 203
SACRAMENTO, CA 95815
(916) 922-5888 Fax (916) 923-2548
E-mail: dbalint@walnuts.org**

February 28, 2001

Prepared for California Department of Pesticide Regulation

DISCLAIMER

The statements and conclusions in this report are those of the contractor and not necessarily those of the California Department of Pesticide Regulation. The mention of commercial products, their source, or their use in connection with material reported herein is not to be construed as actual or implied endorsement of such products.

ACKNOWLEDGEMENTS

The research in this paper was conducted with the assistance of the following partners:

Walnut Marketing Board

Dennis Balint
1540 River Park Dr.
Suite #203
Sacramento, CA 95815
(916) 646-3807
dbalint@walnuts.org

David Ramos
2536 Corona Drive
Davis, CA 95616
(530) 756-0531
deramos@ucdavis.edu

Community Alliance with Family Farmers

Molly Johnson
P.O. Box 363
Davis, CA 95617
(530) 756-8515
molly@caff.org

Industry Leaders

Jack Jenkins
Pacific Biocontrol Corporation
620 E. Bird Lane
Litchfield Park, AZ 85340
(623) 935-0512
Jenkins@doitnow.com

Ross Stocker
Arena Pest Management
Aerial Trichogramma Applicator
(530) 757-1550
arena@afes.com

Field Assistants

Nicole Darby, Sacramento Valley
Michelle Rego, San Joaquin Valley

Cooperating University of California Researchers

Dr. Nick Mills
University of California, Berkeley
Biocontrol and Trichogramma
nmills@nature.berkeley.edu

Dr. Steve Lindow
University of California, Berkeley
Blight research
Icelab@socrates.berkeley.edu

Dr. Jim Adaskaveg
University of California, Riverside
Blight model
jim.adaskaveg@ucr.edu

Dr. Steve Welter
Dept. of Environmental Science, Policy, and Management
University of California, Berkeley
Codling moth pheromone and plot design
welters@nature.berkeley.edu

Dr. Robert Van Steenwyk
Dept. of Environmental Science, Policy, and Management
University of California, Berkeley
Reduced Risk Chemicals
hobvanst@nature.berkeley.edu

Cooperating Walnut Growers

Red Bluff Farms, Tehama County
Don O'Dell, Butte County
Mike Bennett, Yuba County
Jack Gilbert, Yuba County
Barton Orchards, San Joaquin County
Chiappe Farms, San Joaquin County
Joe Campos, Fresno County

**University of California Cooperative
Extension**

Walt Bentley
UC Regional IPM Advisor
UC Kearney Ag Center
9240 S. Riverbend Ave.
Parlier, CA 93648
(559) 646-6527
Email: Walt@uckac.edu

Richard Buchner
Tehama County Farm Advisor
P.O. Box 370
Red Bluff, CA 96080
(530) 527-3101
Email: rpbuchner@ucdavis.edu

Mark Freeman
Fresno County Farm Advisor
1720 So. Maple Ave.
Fresno, CA 93702
(559) 456-7265
Email: mwf Freeman@ucdavis.edu

Joe Grant
San Joaquin County Farm Advisor
420 S. Wilson Way
Stockton, CA 95205
(209) 468-2085
Email: jagr ant@ucdavis.edu

Janine Hasey
Sutter/Yuba Counties Farm Advisor
142-A Garden Highway
Yuba City, CA 95991
(530) 822-7515
Email: jkhasey@ucdavis.edu

Bill Olson
Butte County Farm Advisor
2279-B Del Oro Ave.
Oroville, CA 95965
(530) 538-7201
Email: wholson@ucdavis.edu

Carolyn Pickel
UC Regional IPM Advisor
142-A Garden Highway
Yuba City, CA 95991
(530) 822-7515
Email: cypickel@ucdavis.edu

Tim Prather
Dept. PSES, College of Agriculture
Moscow, ID 83844
(208) 885-9246
Email: prather@uidaho.edu

Terry Prichard
Extension Irrigation Specialist
420 S. Wilson Way
Stockton, CA 95205
(209) 468-2085
Email: tlprichard@ucdavis.edu

Bill Krueger
Glenn Co Farm Advisor
P.O. Box 697
Orland, Ca 95963-0697
(530) 865-1109
Email: whkrueger@ucdavis.edu

0329

This report was submitted in fulfillment of Contract Number 98-07, A Reduced-Risk Pest Management Program for Walnuts, by the Walnut Marketing Board under the partial sponsorship of the California Department of Pesticide Regulation. Work was completed as of February 28, 2001.

TABLE OF CONTENTS

Abstract	1
Executive Summary	2
Introduction.....	3
Materials and Methods	3
Results	7
Objective 1: Continue to build upon the Walnut Pest Management Alliance Team for implementation of reduced-risk strategies and to extend the information to growers	7
Objective 2: Demonstrate IPM strategies to control codling moth, <i>Cydia</i> <i>pomonella</i>	8
Objective 3: Demonstrate IPM strategies to control walnut blight, <i>Xanthomonas</i> <i>Campestris</i>	16
Objective 4: Demonstrate the impacts of a replanted cover crop, a naturally reseeding cover crop, and native vegetation.....	17
Objective 5: Monitor for additional walnut pests: mites, aphids, and walnut husk fly.....	21
Objective 6: Assess the economic impact of a reduced-risk program as compared to conventional practices.	25
Objective 7: Record pesticide use in commercial walnuts over a 10-year period	27
Discussion.....	31
Summary and Conclusions	32
References	34
Appendices	
Appendix A: California Walnut Commission Summer, Fall, and Winter Reports, 2000-2001	
Appendix B: <i>Walnut Research Reports, 2000</i> "Walnut Pest Management Alliance 2000: Year 2 Update	

Appendix C: Regional meeting agendas from January 13, 14, and 21, 2000.

Appendix D: Article from *Diamond of California Walnut News and Review*, January 2000, "Growers Take Stewardship Roles Seriously".

Appendix E: Article from *Diamond Walnut News*, April 2000, "Walnut PMA Narrows Focus".

Appendix F: Article from California Farm Bureau's *Ag Alert*, February 9, 2000, "Walnut Growers Reducing Risks in Their Orchards".

Appendix G: Article from California Farm Bureau's *Ag Alert*, September 13, 2000, "IPM program for Codling Moth Control is expanded".

Appendix H: Meeting Agenda from Walnut PMA and San Joaquin BIOS Project joint field meeting on August 30, 2000.

Appendix I: BIOS project Grower Questionnaire.

LIST OF FIGURES AND TABLES

- Chart 2.1.a. Percent codling moth damage at harvest by treatment.
- Chart 2.1.b. Percent codling moth damage at harvest at San Joaquin site.
- Chart 2.1.c. Percent codling moth damage at harvest at Yuba site.
- Chart 2.1.d. Percent codling moth damage at harvest at Butte site.
- Chart 2.1.e. Percent codling moth damage at harvest at Tehama site.
- Chart 2.2.a. Correlation of nut drop per tree versus harvest data.
- Chart 2.2.b. Seasonal nut drop averages per tree.
- Chart 2.3.a. Walnut damage at canopy count 1 versus harvest data.
- Chart 2.3.b. Average damage per tree after canopy count 1.
- Chart 2.4.a. Walnut damage at canopy count 2 versus harvest data.
- Chart 2.4.b. Average damage at canopy count 2.
- Table 3.1. Bioassay results from dormant walnut buds, 2000.
- Table 3.2. Percent walnut blight.
- Chart 4.1. Biomass production, cover crop and conventional at two sites, 1999.
- Chart 4.2. Biomass sources, cover crop and conventional, Bear River site, 1999.
- Chart 4.3. Biomass nitrogen at Bear River site, 1999.
- Table 4.1. Plant species present in two Walnut PMA orchards.
- Table 4.2. Fall, winter weed occurrences for cover crop and conventional at Deseret.
- Chart 4.4. Biomass accumulation, 2000.
- Table 5.1. Seasonal totals of walnut aphids and mummies.
- Table 5.2. Seasonal totals of dusky-veined aphids and beneficial insects.
- Chart 5.1. Fresno County seasonal mite counts.
- Chart 5.2. Yuba County seasonal mite counts.
- Chart 5.3. Butte County seasonal mite counts.
- Table 6.1. Costs per acre for material, machinery, and labor in the Walnut PMA, 2000.
- Table 6.2. Costs for reduced-risk treatments in Walnut PMA 2000.
- Table 6.3. Costs for Grower Standard treatments.
- Chart 7.1. California harvested walnut acreage 1991-1999.
- Chart 7.2. Organophosphate use in CA 1990-1999, lbs/acre.

Chart 7.3. Pounds of organophosphate used per year in 6 counties.

Chart 7.4 Pounds of organophosphate used per acre in 6 counties.

Chart 7.5 Pounds of pyrethroid applied in CA per year.

Chart 7.6. Pounds of Bt applied 1991-1999.

Chart 7.7. Pounds of Bt applied per acre 1991-1999.

Chart 7.8. Total pounds of Bt used in walnuts in CA.

ABSTRACT

The Walnut Pest Management Alliance (PMA) was formed by the alliance of California Department of Pesticide Regulation (DPR), the Walnut Marketing Board, and the University of California Cooperative Extension in 1998 to evaluate the possibility of managing pests with reduced-risk pesticides in response to the Food Quality Protection Act (FQPA). The alliance includes the Walnut Marketing Board, University of California Cooperative Extension, University researchers, the Community Alliance with Family Farmers (CAFF), walnut growers, and Pest Control Advisors (PCA). Within this alliance, there are three regional leaders, a management team, cooperating farm advisors, and regional field scouts. The walnut PMA work plan continues the broad-based validation and implementation project designed to encourage adoption of reduced-risk pest management program in walnuts statewide. The focus of the Walnut Pest Management Alliance (PMA) proposal is to continue current efforts to develop and demonstrate reduced-risk management strategies on walnuts, and to improve communication and cooperation among different groups involved in developing economical reduced-risk walnut production. Growers have not readily adopted these reduced-risk alternatives because they are perceived by growers as higher risk and more expensive than using conventional broad-spectrum insecticides. The key to meeting CDPR priorities and key practices in walnuts include: Development of successful pest management systems that demonstrate alternatives, especially for codling moth and blight, that will minimize the use of organophosphate and pyrethroid insecticides, fungicides, and herbicides under review by FQPA. Through this effort, surface water contamination by organophosphates used in sprays can be reduced or eliminated. This project will address the challenges of using cover crops in walnuts and demonstrate orchard floor management that incorporates cover crops, optimizing nitrogen, weed control, and irrigation. This will result in reduced groundwater contamination by soil sterilants such as simazine and diuron. Soil moisture monitoring and appropriate irrigation scheduling will optimize water use, preventing tree water deficit stress and excess water application resulting in runoff and/or excessive deep percolation when cover crops are used. Human exposure to pesticides due to off-site movement and reduced fieldworker exposure will result from adoption of the Walnut PMA program. Resistance will be delayed by reducing the amount of insecticides and employing existing and new monitoring programs. Relying on monitoring techniques, predictive models and biological controls will reduce the risk of codling moth and blight damage as well as insecticides, miticides and fungicides. These goals will be reached by developing management techniques from research funded by the Walnut Marketing Board, using UC IPM monitoring programs, and outreach techniques employed by BIOS.

EXECUTIVE SUMMARY

The Walnut Pest Management Alliance (PMA) was established with the funding provided by California Department of Pesticide Regulation (CDPR) in 1998 to develop a statewide broad-based demonstration and implementation project designed to encourage adoption of reduced-risk pest management programs in commercial walnuts. The PMA is a response to the Food Quality and Protection Act in 1996 and growing concern about increasing regulations. The PMA is a cooperative group effort that includes the University of California research and extension, walnut growers and industry, Biologically Integrated Orchard Systems (BIOS), and pest control advisors.

In the second year of the Walnut PMA, the program continues to promote reduced-risk practices and to improve communication and cooperation among the groups involved. The framework of the Walnut PMA is to:

- Build a team of people from various organizations to drive the Walnut PMA.
- Establish demonstration sites and develop positive relationships with the growers involved.
- Promote reduced-risk practices in commercial walnuts to address FQPA and environmental issues that, in turn, promote worker safety.
- Standardize monitoring statewide, yet remain aware of regional issues.
- Extend information so that all growers have access.

The Walnut PMA's seven objectives promote cooperation and communication between the groups involved and evaluate reduced-risk strategies for codling moth, *Cydia pomonella*, and walnut blight, *Xanthomonas campestris*. Also, cover crop and run-off issues are addressed as well as monitoring for other pests including walnut husk fly, aphids, and mites. In addition, the Walnut PMA assesses the economics of implementing a reduced-risk program and delves into pesticide use reports. These efforts attempt to study and implement reduced risk practices and evaluate the economic damage of pests.

The Walnut PMA codling moth objective included six early cultivar walnut orchards of either Ashley or Vina varieties ranging from Fresno to Tehama County. The walnut blight objective monitored blight populations in the dormant season and again in late May to determine damage levels across treatments. The cover crops, one replanted and one allowed to reseed on its own, were assessed in the spring to determine reseeding and population. The economics depict the costs of these reduced-risk programs. Finally, the compilation of the pesticide use reports give insight as to when these pesticides are being applied, the amount being applied, and the amount of acreage on which commercial walnuts are grown.

Future improvements of the Walnut PMA will emphasize implementation of new mating disruption products and walnut blight monitoring programs, expand cover crop demonstrations to address pesticide run-off concerns, and standardize monitoring of other pests such as aphids and mites.

The second year of the Walnut PMA found:

- Mating disruption treatments were effective for codling moth control.
- Growers are interested and willing to participate in using reduced-risk practices.
- Continued commitment from the Walnut PMA Team.
- Development of new promising mating disruption products which will be available to growers in the near future and are easier to apply to large walnut canopies.

Growers have not readily adopted these reduced-risk alternatives because these practices are perceived as a high economic risk because they are more expensive than using conventional broad-spectrum insecticides. Reduced-risk programs require multiple years of implementation in order to gain the confidence of commercial walnut growers. The performance of reduced-risk techniques requires a commitment and teamwork so that the long-term effects are accurately studied. Failure to adequately research reduced-risk products may lead to devastating economical effects of increased pest pressures.

INTRODUCTION

The objectives of the second year Walnut PMA were to focus on reduced-risk techniques with an emphasis on standardizing the treatments statewide in accordance with FQPA and continuing pressure applied by environmental groups to limit conventional pesticide use. By building from the positive responses from the first year, we continued to implement reduced-risk practices coupled with educational meetings. To compliment the framework, there were 7 objectives:

- (1) Build upon the teamwork between the University of California Cooperative Extension, BIOS, University Researchers, Industry leaders, PCAs, and growers
- (2) Control codling moth using reduced-risk practices and to develop monitoring programs to predict pest levels.
- (3) Develop reduced-risk practices to control walnut blight based on monitoring programs.
- (4) Demonstrate the benefits of cover crops.
- (5) Monitor for additional pests.
- (6) Show the economic impact of a reduced risk program.
- (7) Show pesticide use history in commercial walnuts.

The PMA is a multi-faceted program that encompasses various technologies in order to assist in driving the walnut industry into adopting reduced risk strategies.

MATERIALS AND METHODS

Objective 1: Continue to build upon the Walnut Pest Management Alliance Team for implementation of reduced-risk strategies and to extend the information to growers.

The Walnut PMA Management Team is the drive behind the Walnut PMA. The Management Team is responsible for directing and implementing reduced-risk strategies. The Team incorporates many players into the program and seeks new ideas constantly. By meeting throughout the year to plan, coordinate, and share new ideas, the Management Team is able to

work effectively and efficiently to ensure that the PMA gathers the most reliable and accurate data possible, and to develop programs that can be rapidly adopted by growers.

Extending information in conjunction with other partners is important. A wide variety of information can be presented in one arena and growers are able to participate in the process.

Objective 2: Demonstrate IPM strategies to control codling moth, *Cydia pomonella*.

Six early cultivar orchards that are codling moth susceptible varieties were chosen for the plots ranging from Fresno to Tehama County. All orchards were under 35 feet in height, and were either the Vina or the Ashley variety. Five treatments consisted of: Isomate C+ alone, Isomate C+ and *Trichogramma planteri*, Isomate C+ and chlorpyrifos or tebufenozide, the Grower Standard, and the untreated control. Yuba County contained two extra treatments, a Consep pheromone treatment and Consep with chlorpyrifos treatment. All treatments were approximately five acres with the exception of the untreated control that was approximately one acre. The untreated control was located at least 150 feet from the pheromone treatments. Isomate C+ was applied once by hand shortly after biofix at a rate of 400 per acre. Chlorpyrifos or tebufenozide was applied during the 1A and/or 1B flight. *T. planteri* was aerially applied once per week for four weeks during the second generation and once per week for four weeks during third generation at a rate of 200,000 per acre. The grower standard consisted of the growers' normal farming practices which typically includes organophosphate and pyrethroid use. Consep pheromone was applied at the same time as Isomate C+. Each orchard was monitored weekly from biofix to harvest. Trece® Delta Traps were used and the liner changed as necessary. Each treatment contained two delta traps, one hung low and one hung high in the canopy in the center of each treatment. In each of the pheromone treatments, the low trap contained the Trece® L2 lure, and the high trap contained the Trece® MegaLure. The grower standard and the untreated treatments were monitored with the Trece® L2 lure positioned low and high. The pheromone lures were changed according to protocol, approximately after 10 weeks. Five trees were selected at random in each treatment and monitored throughout the season. The overwintering generation was monitored by nut drop, subsequent generations were monitored by canopy count, and the final evaluation with a harvest sample.

Objective 3: Demonstrate IPM strategies to control walnut blight, *Xanthomonas campestris*.

Six orchards were surveyed during the winter 2000 by collecting dormant walnut buds. Bioassays of these buds were conducted for the presence of walnut blight bacteria at Dr. Steve Lindow's laboratory at University of California, Berkeley for the percent of buds containing walnut blight bacteria and the amount of bacteria colony forming units (CFU) in the buds. The University of California Farm Advisors used this information to advise their cooperating growers of the "Blight Risk" in their orchards and recommended treatment strategies based on the bioassays.

Five University of California Farm Advisors conducted uniform efficacy trials to evaluate a reduced-risk approach to controlling walnut blight. The reduced-risk treatment was an eradicant spray containing copper and Manex (where registered) plus the wetting agent Break-thru and was applied only once at bud break.

The treatment timings were as follows: bud break only, bud break plus grower standard, grower standard, and untreated.

The materials used were 0.5% Break-thru by volume with the bud break spray, 8 pounds of fixed copper/acre with each grower standard spray plus 58 oz. Manex / acre (where registered) at 100 gallons per acre. Break-thru is a silicon wetting agent used to help carry the copper/Manex into the buds. An orchard air blast sprayer applied materials at bud-break and/or various other times during the spring.

Objective 4: Demonstrate the impacts of a replanted cover crop, a naturally reseeding cover crop, and native vegetation.

The cover crops evaluated in 1999 were evaluated again in 2000 for plant species and biomass. The two cover crops evaluated are in Yuba County. Each orchard contained one planted cover crop treatment and a native vegetation treatment. One cover crop was manually reseeded in the winter of 1999 and the second cover crop was allowed to reseed naturally. Upon evaluation in May 2000, one orchard had mowed the native vegetation, the grower standard, and therefore a comparison of plant species could not be made at this site.

Objective 5: Monitor for additional walnut pests: mites, aphids, and walnut husk fly.

Other important potentially economically threatening pests were monitored throughout the season. Pests such as mites, aphids, and walnut husk fly were monitored as needed in some orchards

Trece Pherocon® unbaited yellow traps were used for monitoring walnut husk fly, *Rhagoletis completa*. Traps were placed high on the north side of the canopy and monitored weekly from June through harvest. Flies were collected from the traps and taken back to the laboratory for further study. A determination between male and females flies was made. Female flies were further inspected to determine if they were gravid. If gravid females were found, then it was recommended that a malathion and bait application be made within 7 to 10 days of finding gravid females. Traps were baited with ammonium carbonate superchargers and changed every three weeks or as necessary. Traps were placed in the control, Isomate C+ only, and grower standard treatments of the codling moth trial.

Walnut aphid, *Chromaphis juglandicola*, sampling began in May. Samples were taken from five leaflets from 20 trees at head height and the lower side of the leaves inspected for walnut aphid and walnut aphid parasite, *Trioxys pallidus*. The number of walnut aphids and the number of mummies were recorded. Random samples were taken every other week until the population increased and then samples were taken weekly. The treatment threshold was considered when more than 15 aphids were found per leaflet, and there was less than one mummy per 10 aphids. If there is one mummy per 10 aphids, then another sample should be taken before determining the need for treatment. Walnut PMA blocks are encouraged to use oil applied at a rate of 4 gallons per 200-400 gallons as a reduced risk treatment for walnut aphid.

Dusky-veined aphids, *Callaphis juglandis*, sampling began in May. The same leaf inspected for walnut aphid was used to determine dusky-veined aphid populations. Dusky-veined aphid populations were determined by counting colonies on a presence/absence scale. A colony

consists of more than 5 aphids (nymphs or adults) on a leaflet. If 10% or more of the leaflets have dusky-veined aphid colonies, then a treatment should be considered for that block. Before treating, predators were noted in order to ensure a treatment would be necessary. The reduced-risk treatment for dusky-veined aphids consists of an oil application of 4 gallons in 200-400 gallons anytime between June and August.

Pacific mite, *Tetranychus pacificus*, two-spotted mite, *Tetranychus urticae*, and European red mite, *Panonychus ulmi*, sampling began in June and continued once per week until a treatment decision is made. After a treatment decision is made, sampling continued every other week. In Fresno, Yuba, and Butte counties, twenty trees were chosen in a treatment receiving an organophosphate spray and twenty trees were chosen in a treatment not receiving an organophosphate spray. These trees were located in known hotspots and the same trees monitored every week. Five leaflets were randomly selected low in the canopy and five leaflets were randomly chosen from high in the canopy on the southeast quadrant of the tree, totaling 200 leaves inspected per treatment. Tehama County monitored in the same fashion, however, 20 trees were chosen at random and 12 leaves per tree were inspected. In Yuba and Butte counties, in August, the sampling protocol was changed and in each of the codling moth treatments, 5 trees were selected randomly, 5 leaflets were chosen low in the canopy and 5 leaflets were chosen high in the canopy. The number of leaflets with mites was recorded. Mite predators such as the western predatory mite, *Typhlodromus occidentalis*, and six-spotted thrips were recorded. If predaceous mites or six-spotted thrips are present on at least half of the leaflets that have mites, then natural enemies will control the population. If mite populations do not build up by the middle of August, then a treatment may not be warranted. The treatment thresholds for mites are:

- If an organophosphate or pyrethroid will be applied and no predators are present, then spray at 10% infested leaflets.
- If an organophosphate or pyrethroid will be applied and predators are present on 10% infested leaflets, then spray at 20% infested leaflets.
- If no organophosphate or pyrethroid will be applied and no predators are present, then spray at 30% - 40% infested leaflets.
- If no organophosphate or pyrethroid will be applied and predators are present at 20% - 25%, then spray at 40% - 50% infested leaflets.

Objective 6: Assess the economic impact of a reduced-risk program as compared to conventional practices.

Accurate economic data was collected on all materials evaluated. Materials, rates of sprays, number of applications, and application costs were recorded. Because many of these reduced risk materials are not used as readily as conventional materials, the cost of reduced-risk materials will be more expensive than the standard. However, recording the costs gives an insight as to future prices as these products become more widely used and as application methods become refined.

Objective 7: Record pesticide use in commercial walnuts over a 10-year period.

By accessing the California Agricultural Statistical Service, Pesticide Use Reports from Department of Pesticide Regulation, and University of California IPM web site, data regarding

walnut acreage and pesticide use has been compiled. This information is important in order to recognize pesticide use trends. This information can be used to determine how much of a potential harmful product is used and it can be used to determine how proactive growers can be in utilizing such reduced-risk alternatives as *Bacillus thuringiensis* and tefenobucide.

Overall, the Walnut PMA project was successful this year. The project began with six orchards but due to a perceived potential pest problem, one orchard was sprayed with a pyrethroid. This hampered the reduced-risk treatments and therefore, results from this orchard could not be used.

The Walnut PMA is built upon teamwork and the experience of the Management Team. Cooperation is the key component in the PMA. Each group is better equipped to research reduced-risk products in conjunction with other groups. With this background, reduced-risk strategies can be researched on a large scale efficiently.

RESULTS

Objective 1. Continue to build upon the Walnut Pest Management Alliance Team for implementation of reduced-risk strategies and to extend the information to growers.

The Walnut Pest Management Alliance Team has been proactive in implementing reduced risk practices and keeping the information moving from Farm Advisors, to field scouts, and to the end users including growers, PCAs and BIOS projects. Continuing to publicize reduced risk practices is the foundation for it to become more widely used. The PMA Management Team continues to drive the implementation and research required for adoption of these new practices. The Walnut Pest Management Alliance Team met June 2 and December 1 in 2000 to develop monitoring protocols, review data collected, plan educational programs and to share ideas for the next season.

Information is extended to growers via field meetings; the biannual Walnut Marketing Board meetings; the Walnut Marketing Board annual research reports, which are readily available for growers; and the PMA progress reports inserted into the Board newsletter mailing, which is sent to all 5500 walnut growers (Appendix A). Results from the 2000 season were reported in the *Walnut Research Reports, 2000* "Walnut Pest Management Alliance 2000: Year 2 Update" (Appendix B). This report is published and made available to all walnut growers. By working with proactive walnut growers, the PMA has earned the trust of the grower/cooperator. By earning this trust, this research can occur in commercial orchards. Information is disseminated to cooperators and interested allied industry through Regional Team Meetings. These meetings are attended by all of the partners including grower cooperators, Walnut Marketing Board research committee members, PCAs, BIOS representatives, and the local Diamond Walnut field personnel. There were three regional meetings held on January 13 in Yuba City, January 14 in Stockton, and January 21 at Kearney AG Center (meeting agendas, Appendix C). This was followed up with a statewide Management Team meeting on June 2 in Stockton.

The results of the fieldwork were reported at the 33rd Annual Walnut Research Conference. An Update on Walnut PMA was presented at three walnut commodity meetings sponsored by farm advisors in Tehama County, Yolo County, and Tulare County. Results from the Walnut PMA including an overview of alternative codling moth methods were discussed at a CAFF meeting for Yolo/Solano Counties. Walnut PMA results were presented to the Pomology Extension

Continuing Conference and to the UC Davis Entomology Department and UC Cooperative Extension Joint Workshop. Codling moth results were presented to the San Joaquin Walnut BIOS Project Monthly Meeting on June 13 and December 11. The results of the Walnut PMA were also presented at the 2000 California Conference on Biological Control because of their efforts to integrate biological control into the codling moth control program. Information on the Walnut PMA was presented to 1455 clientele.

Articles were written about the Walnut PMA in *Diamond of California Walnut News and Review* in January 2000, "Growers Take Stewardship Role Seriously" (Appendix D) and in *"Diamond Walnut News* in April 2000, "Walnut PMA Narrows Focus" (Appendix E). There was an article on the "Alternatives for Codling moth in Walnuts" in CAFF's newsletter *Farmer-to-Farmer* May 2000, Issue 1. *Ag Alert* had an article on February 9, 2000, on "Walnut growers reducing risks in their orchards" (Appendix F) and September 13, 2000 on "IPM program for codling moth control is expanded" (Appendix G).

This year, the Walnut PMA and the San Joaquin BIOS project held a joint field meeting in a central location in the state. This meeting was held in San Joaquin County on August 30, 2000 (Appendix H). Approximately 100 people attended. In a survey conducted by BIOS, growers answered a questionnaire evaluating the meeting (Appendix I).

This questionnaire also provides information regarding how and where growers receive their information. From the growers who answered, 41% of attendees learned of the meeting via their local Farm Advisor, 46% learned from print media, and almost 8% from a co-worker.

From those that answered, 68.5% answered that the information presented at the meeting will be useful in their own orchards, 31.4% found that the information may be used at some point, and there were no negative results. Therefore, the information presented at this meeting was useful and growers felt that much of it was applicable in some capacity in their own orchards.

When asked which part of the field meeting was most useful, 13.8% found that all of the information was useful. However, 16.6% responded that the research findings were most useful and 13.8% responded that the information on mating disruption was most useful.

These meetings are generally conducted to give the most information in only a few hours. Allowing for discussion regarding each topic is usually difficult to integrate into meetings. However, 77% of the growers who responded felt that the meeting provided ample time for discussion regarding the topics.

Objective 2. Demonstrate IPM strategies to control codling moth, *Cydia pomonella*.

Harvest Damage. The damage at harvest is the easiest way for growers to evaluate treatments. Two demonstration orchards and the Consep treatments from Yuba County were not used in the harvest analysis. One orchard had zero damage across treatments and the other orchard applied a pyrethroid over the reduced-risk treatments, thereby rendering the reduced-risk treatments invalid for this report. Results from each treatment were calculated by percent damage based on the untreated check and analyzed using transformed data and a two-way ANOVA. In Yuba County, the grower standard treatment was not included in this analysis because this orchard did not treat the grower standard. Chart 2.1.a. shows percent codling moth damage at harvest per

treatment in the Walnut PMA 2000, and is an average of all sites. The data was transformed and a two-way ANOVA performed. Due to the high variance, there is no difference in the treatments. However, the Isomate C+/Lorsban- Confirm treatment again showed the least amount of damage overall.

Chart 2.1.a. Percent codling moth damage at harvest per treatment in the Walnut PMA.

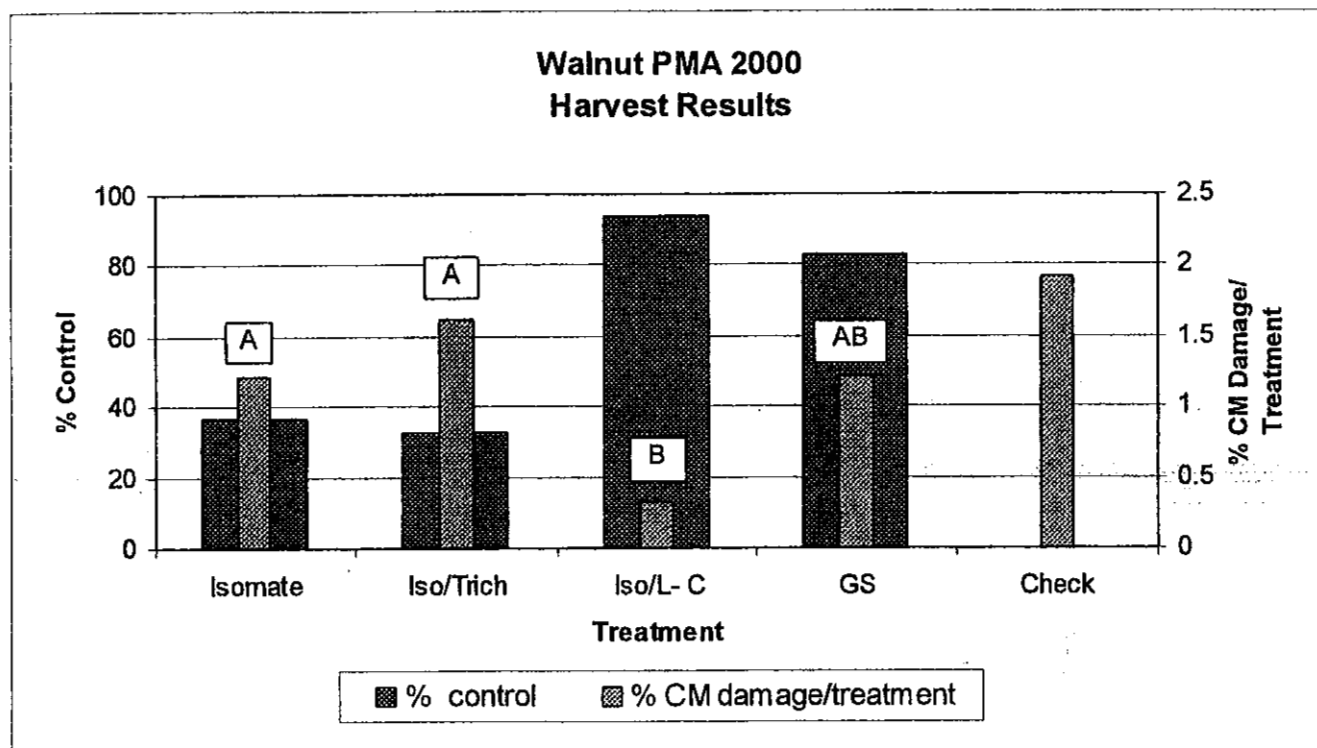


Chart 2.1.b. Percent codling moth damage at harvest at San Joaquin site

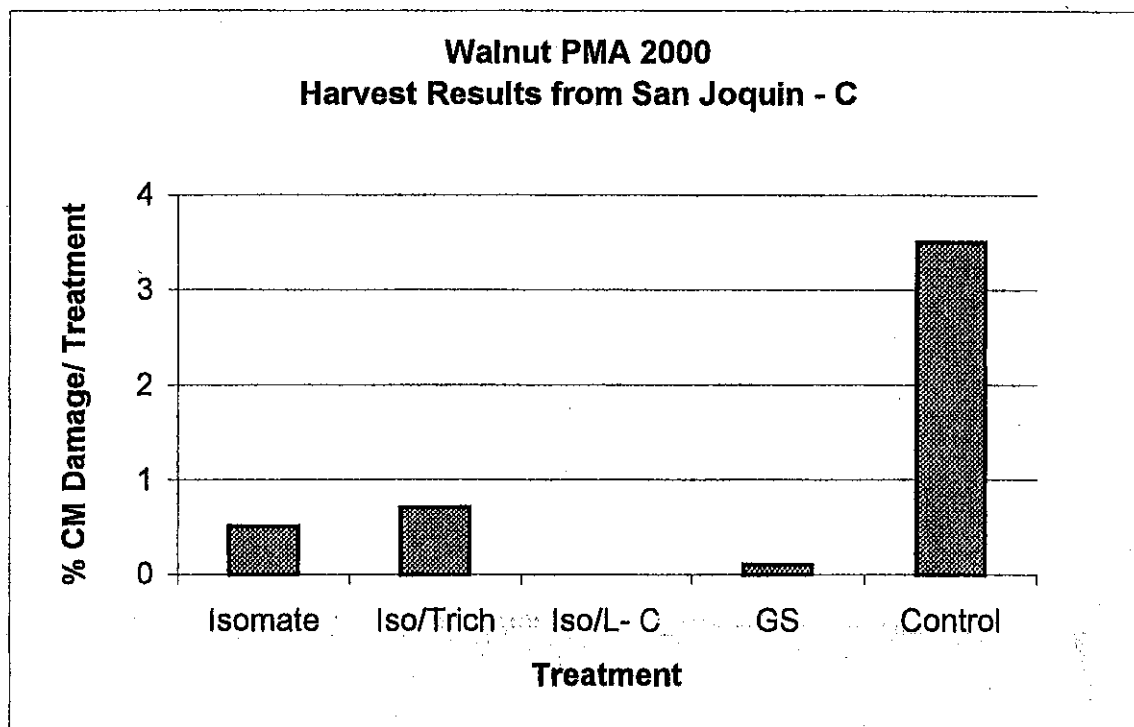


Chart 2.1.c. Percent codling moth damage at harvest at Yuba site

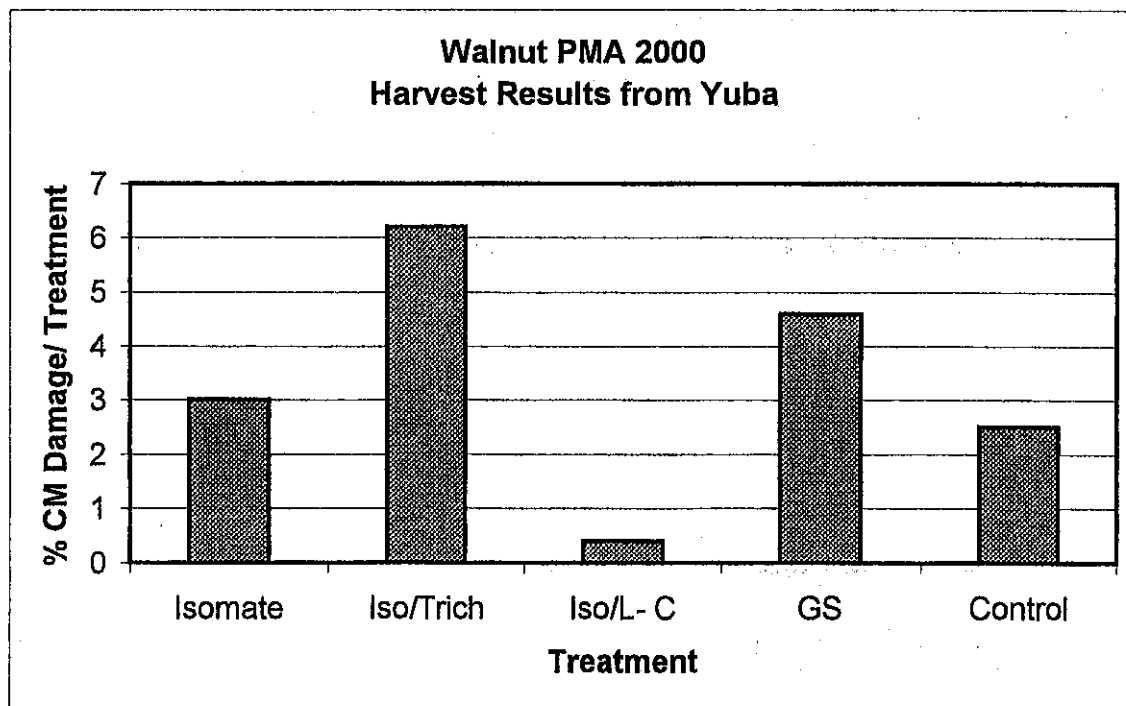


Chart 2.1.d. Percent codling moth damage at harvest at Butte site

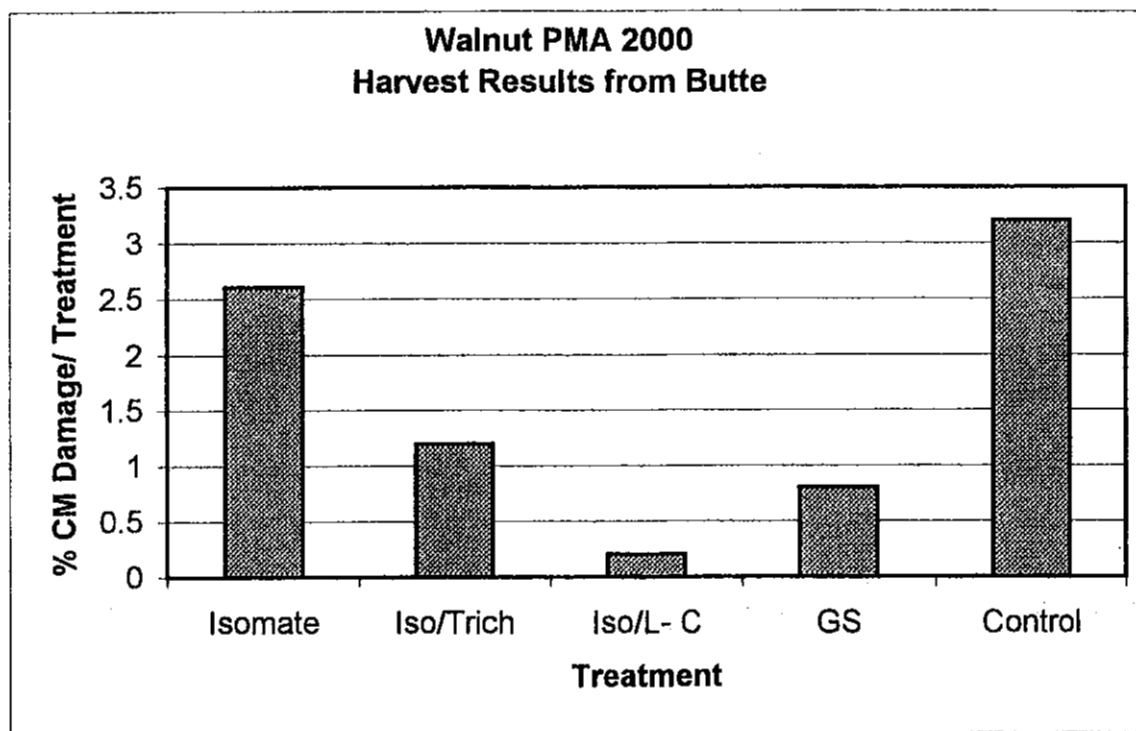
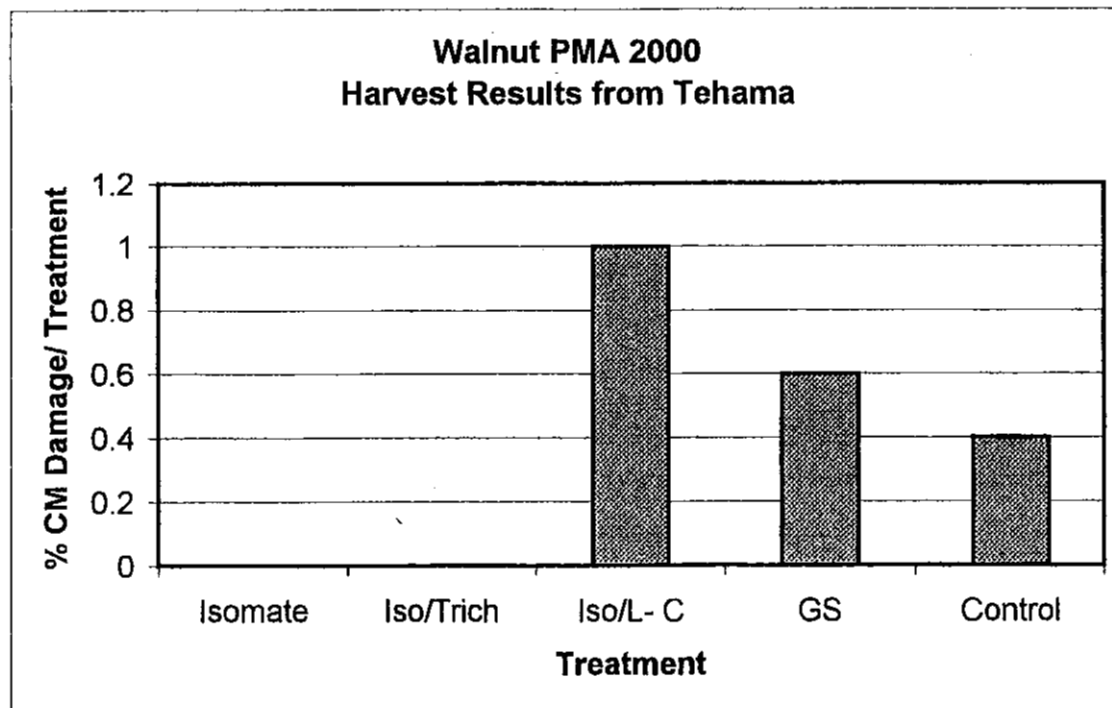


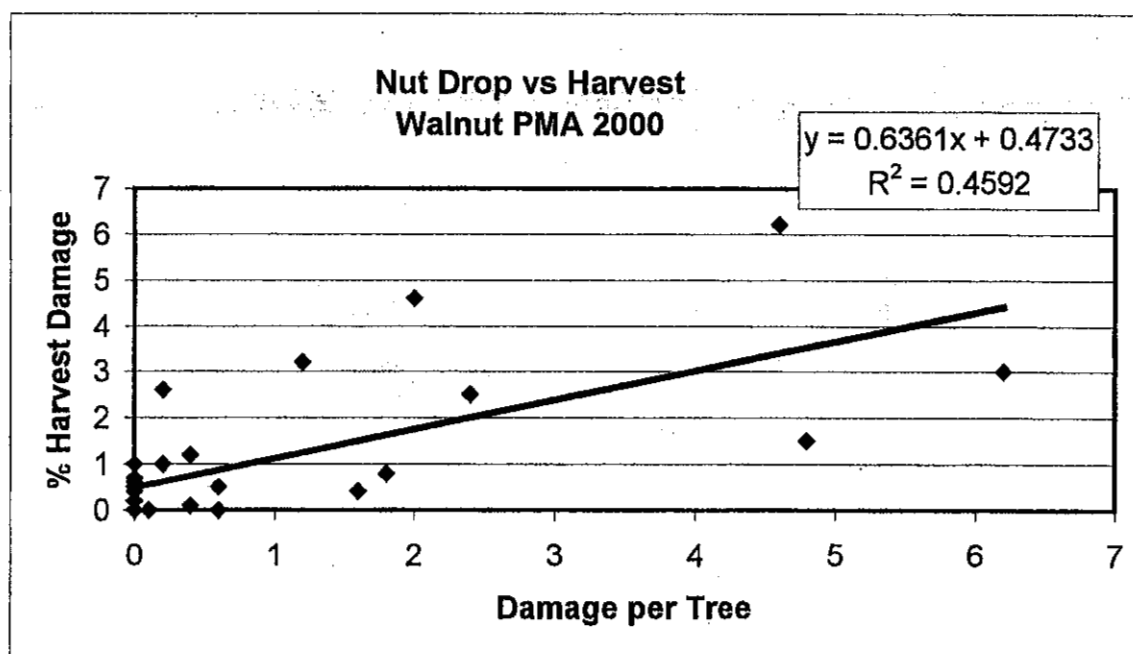
Chart 2.1.e. Percent codling moth damage at harvest at Tehama site



Nut Drop. Monitoring techniques such as nut drop and canopy counts are tools used to determine damage levels at the end of each generation leading to harvest. Nut drop data is an analysis of the amount of damage from the first generation of codling moth. Correlations were conducted at the end of each of these monitoring techniques to harvest damage in order to determine if harvest damage can be predicted from earlier generations. Data collected from all the treatments was used to have data from all population levels.

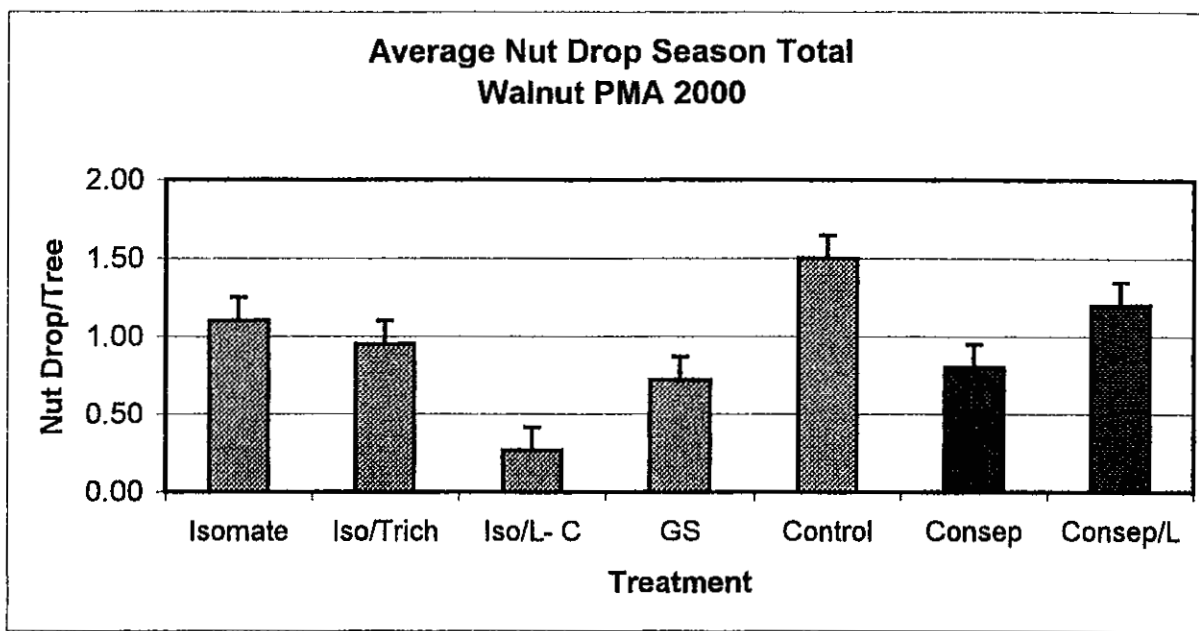
Each orchard was monitored for codling moth infested walnuts that drop from the tree in the overwintering generation or first flight. In each orchard, five randomly chosen trees were selected and marked for use over the entire season. Weekly, the walnuts under each of these five trees were inspected for codling moth damage. The numbers of infested walnuts per tree from the overwintering generation are graphed against the final damage at harvest; Chart 2.2a shows the nut drop data versus the harvest data. The R^2 value is 0.46 which has a high correlation, therefore harvest damage can be accurately assessed by nut drop.

Chart 2.2.a. Correlation of nut drop per tree versus harvest data Walnut PMA 2000.



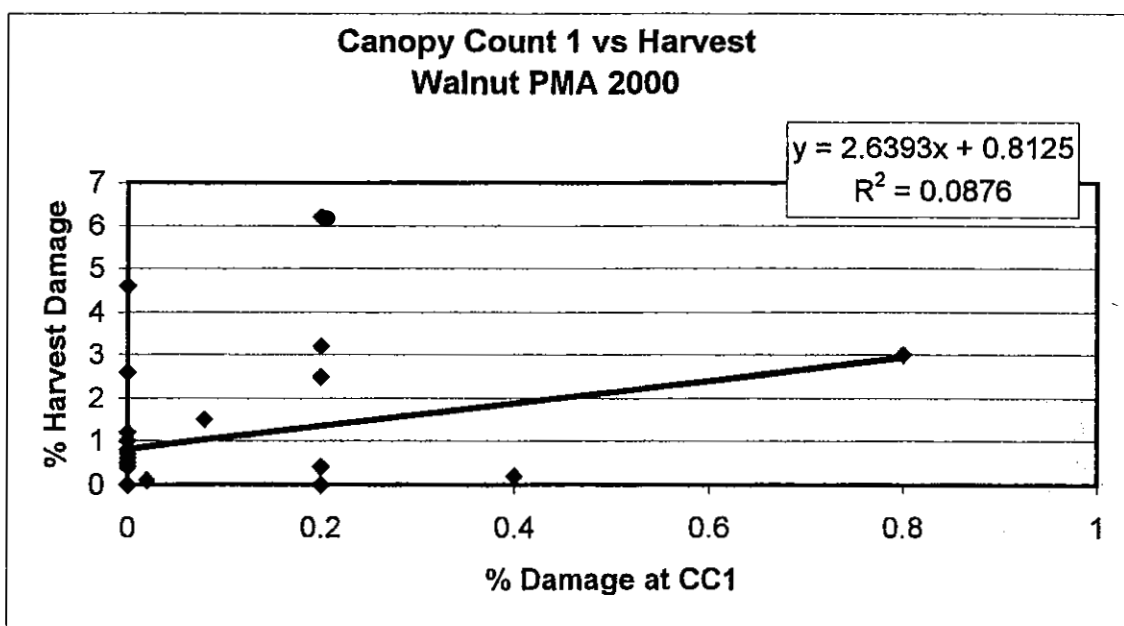
Nut Drop Treatment Effects. Seasonal nut drop per tree for all six orchards, including the Consep treatments from Yuba County are listed below in Chart 2.2b. The Isomate C+ and Lorsban/Confirm treatment has the least amount of damage at the end of nut drop. Trichogramma had not been applied at the time of this sample and would not effect the treatment levels. The two Consep treatments are comparable to the other replicated treatments.

Chart 2.2b. Seasonal nut drop averages per tree in Walnut PMA orchards 2000.



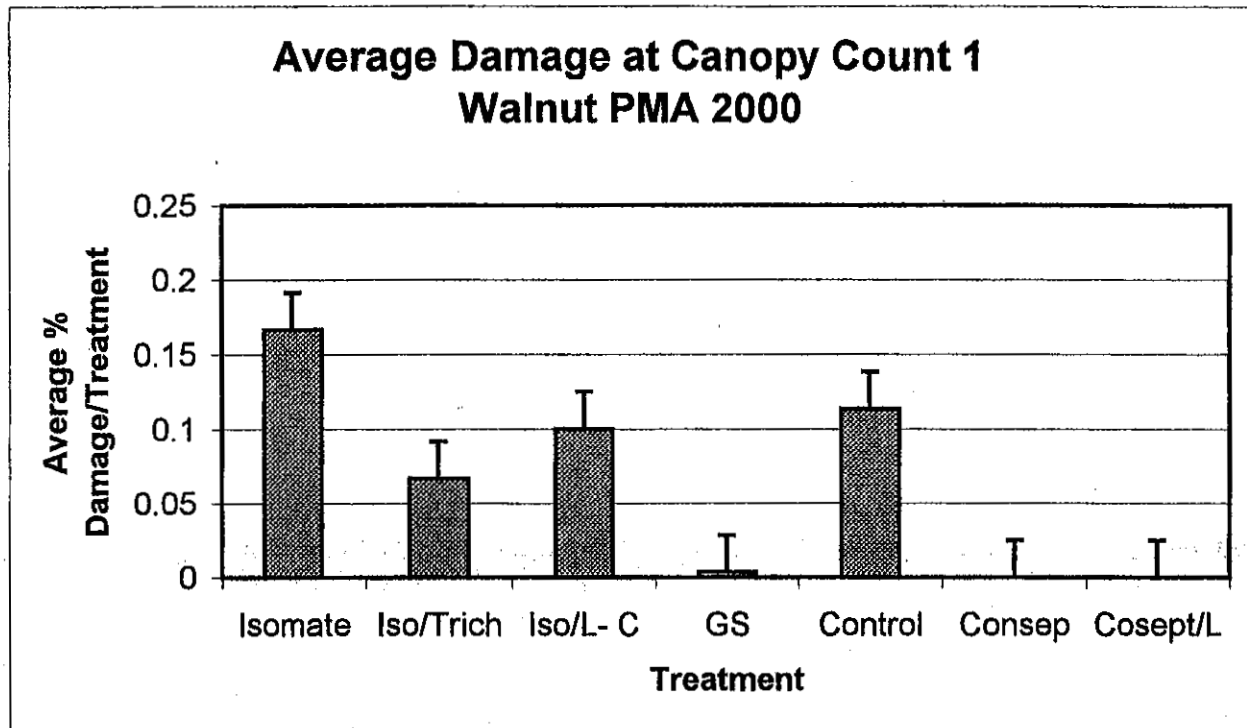
Canopy Counts. Canopy counts were conducted in all six walnut PMA orchards using the same random trees chosen for nut drop. At the end of the overwintering generation, walnuts in the tree were inspected for codling moth damage. A total of 100 walnuts were randomly counted per tree, 500 walnuts per treatment, 50 walnuts were randomly inspected low in the canopy and 50 walnuts were randomly inspected in the canopy using orchard ladders. The percent damage found in the control has been statistically compared to the damage found at harvest. This correlation is noted below in Chart 2.3.a. The damage found after the first canopy count is not correlated to harvest damage; $R^2 = 0.09$. This means that most of the codling moth damaged nuts dropped from the tree and nut drop would be a better monitoring technique to estimate damage at harvest.

Chart 2.3.a. Walnut damage found in the first canopy count versus damage found at harvest in the Walnut PMA 2000.



The average damage after canopy count 1 in all six orchards and the Consep treatments are noted in Chart 2.3.b.

Chart 2.3.b. Average damage per tree after the first canopy count Walnut PMA 2000.



Canopy counts were conducted again at the end of the second codling moth generation, Canopy County 2. They were conducted in the same manner, inspecting walnuts low in the canopy and high in the canopy, using the same trees as for nut drop and the first canopy counts. The correlation from the second canopy counts to the damage at harvest is noted below in Chart 2.4.a. The correlation calculated for the second canopy count to harvest damage has increased ($R^2=0.5$) from the first canopy count and is a good estimate of damage at harvest. Treatment effects are seen by average damage at the end of the second generation per tree and are noted in Chart 2.4.b. Not all of the sites did the second canopy count.

Chart 2.4a. Canopy count damage after the second codling moth generation versus harvest damage in the Walnut PMA 2000.

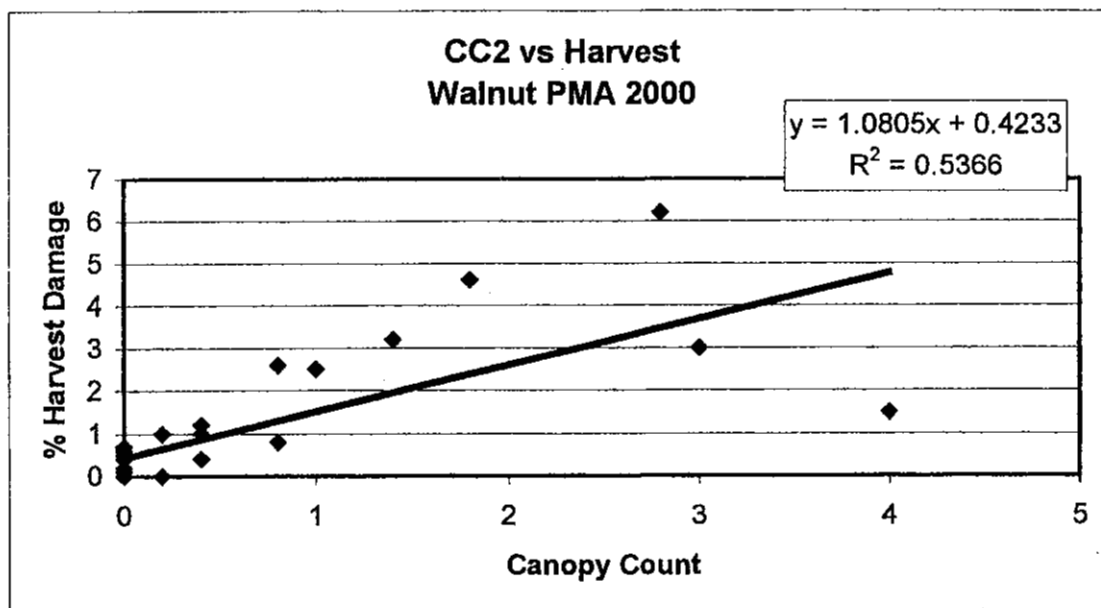
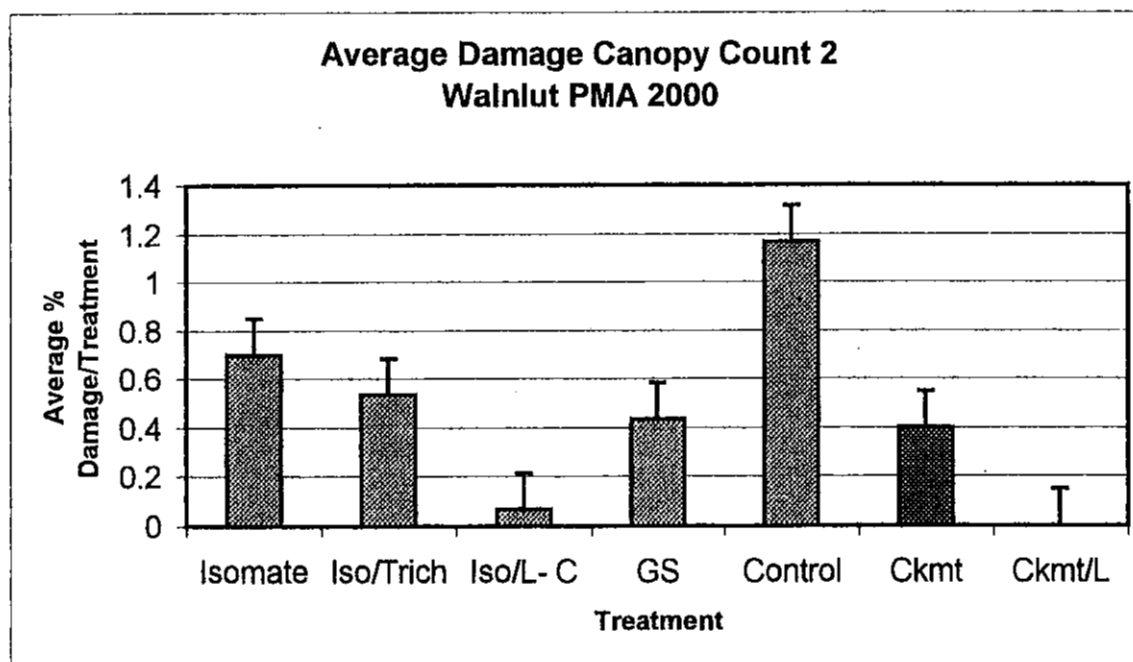


Chart 2.4.b. Average damage at the end of the second generation Walnut PMA 2000.



Nut drop and the second canopy counts show good correlation to damage at harvest. The first canopy count did not show a good correlation indicating that most of the codling moth damage had dropped and was not reflected in the canopy count.

Objective 3: Demonstrate IPM strategies to control walnut blight, *Xanthomonas campestris*.

A summary of the results from the bioassays can be in Table 3.1. The lack of rainfall this spring resulted in very little walnut blight. Consequently, none of the survey orchards had enough walnut blight to validate this method of predicting the amount of walnut blight in the orchard. This predictive model will have to continue for several years to fully measure its reliability and impact.

Table 3.1. Bioassay results from dormant walnut buds Walnut PMA 2000.

County	Avg. Log CFU/Bud	% Bud Infected	Blight Risk
Butte	3.69	100	Very High
Fresno	0.1	3	Very Low
SJ 1	1.22	47	Moderate
SJ 2	0.6	20	Low
Yuba	1.34	34	Moderate

The results from the reduced-risk materials trial can be seen in Table 3.2. The values are expressed in percent walnut blight. With very little walnut blight present at any location no conclusions can be drawn from this years trial. However, the one application bud break spray did reduce the amount of walnut blight in the orchard as compared to the untreated. Also, the single application treatment had nearly the same level of walnut blight as was found in the grower standard treatment, which had multiple applications. To adequately evaluate this treatment more severe walnut blight conditions need to occur.

Table 3.2. Percent walnut blight Walnut PMA 2000.

County	Bud Break Only	Bud Break + Grower Standard	Grower Standard	Untreated
Butte	1.6	1.05	0.85	2.35
Yuba	2.55	3.75	N/A	4.8
Fresno	0	0	0	0
San Joaquin	0.25	0.1	1.45	N/A
Average	0.92	1.05	.73	2.37

Objective 4. Demonstrate the impact of a cover crop, a naturally reseeding cover crop, and native vegetation.

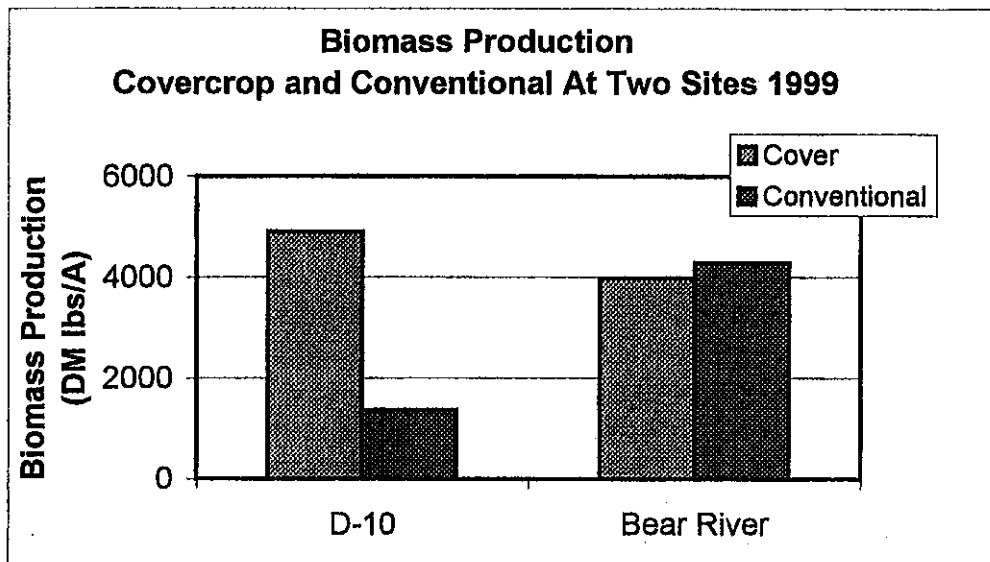
Cover crops grown in tree crops compete with weeds that invade into the tree row, improve soil structure and reduce the amount of water runoff from precipitation. Additionally, cover crops absorb nitrogen during their growth and store it until the winter rains have passed. Upon mowing and subsequent decomposition the nitrogen scavenged from the soil is once again available to the trees. Nitrogen that is not scavenged leaches from the root zone or denitrifies. Both processes result in the loss of the nitrogen from the cropping system.

Two walnut orchards, D-10 and Bear River, were divided into two blocks, one block with a cover crop planted and one block with no cover crop planted (conventional). The conventional block was not prepared in any fashion allowing resident vegetation to seed and grow. Cover crops were planted late in the fall of 1998, after walnut harvest but prior to leaf fall, a very narrow window. The cover crop mix consisted of varieties of subclovers and medics, Blando brome, and Zorro fescue. Zorro fescue bridged across the openings in the seeder box and would not come out of a standard seed drill preventing direct seeding of the cover crop. Each location was disked and cover crops were spread using a broadcast seeder and then seeds were lightly disked into the soil. Weed frequency was calculated using presence/absence data.

Sampling of plant species present in the PMA and grower standard was conducted using 5 transects in each plot with 10 quadrants per transect. Each quadrant was a nested frequency quadrant with dimensions of 0.25 m by 0.25 m and 0.5 m by 0.5 m plot.

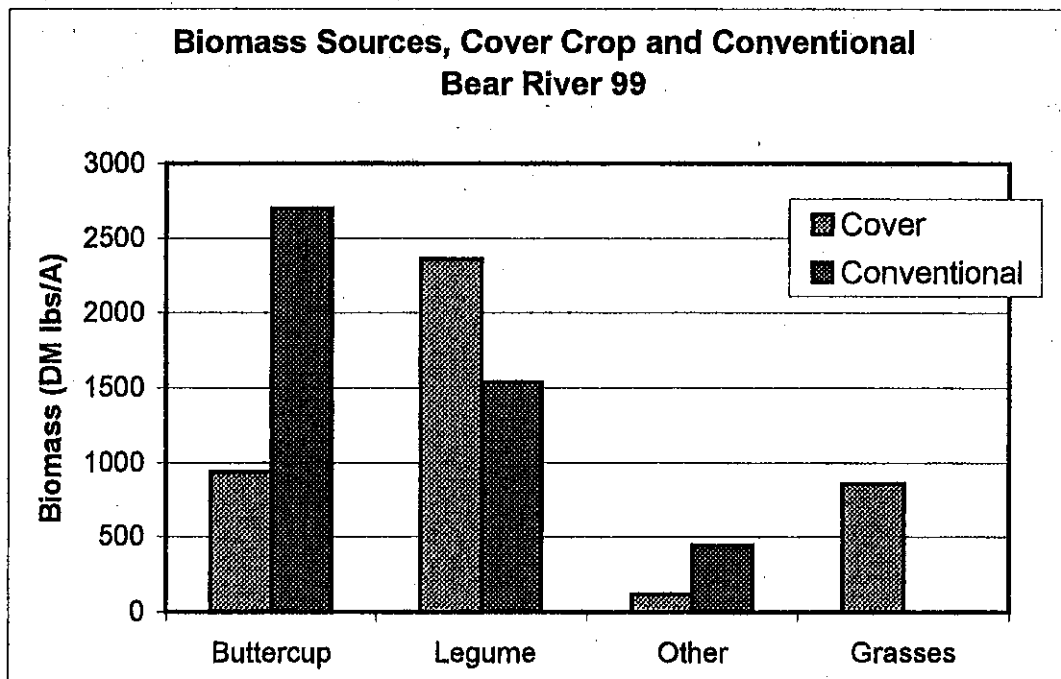
Biomass was measured at each site by clipping the vegetation in a one-square meter area just prior to the spring mowing (5/15). Four replicate areas were clipped in each treatment. Biomass accumulation was found to be significantly different between sites comparing the conventional practice of resident vegetation (Chart 4.1). In orchard D-10, nearly 1400 lbs of dry matter per acre was produced which was significantly below the 4000 pounds produced by the cover crop at the Bear River site. This was attributed to both the species array and the fact that the D-10 site has a more full (shade) canopy, which discourages the long term seed supply. Biomass production of the planted cover crops was similar in each orchard at near 4000 pounds per acre.

Chart 4.1. Biomass Production at Two Sites, Covercrop and Conventional



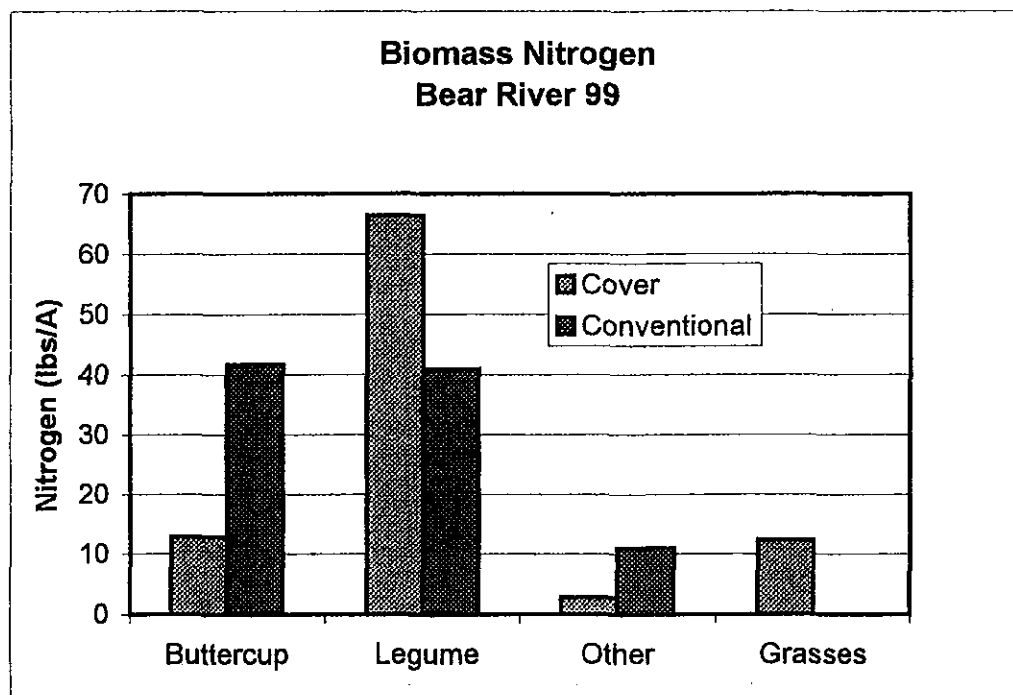
Although the biomass production in the cover crop and conventional were nearly the same in the Bear River orchard, significant differences between species were found. The planted Legumes and grasses were predominant (Chart 4.2.) The increase was at the expense of the Buttercup and "other species".

Chart 4.2 Biomass Sources, Cover Crop & Conventional



The nitrogen content of the clipped sample was analyzed and a nitrogen extracted value calculated. Differences in nitrogen content existed between species with buttercup and grasses the same at 1.5 % and legumes at nearly twice that content at 2.8%. However, given these differences, the mass of the tissue is the primary determinant in the differential nitrogen extracted (Chart 4.3).

Chart 4.3 Biomass Nitrogen at Bear River Site, 1999



The cover crop treatments extracted the same amount of nitrogen/acre; 92 and 94 lbs. The conventional at Bear River also extracted nearly the same at 93 lbs/acre. The D-10 site conventional only extracted 19 lbs/acre of nitrogen.

For the 2000 season site D-10 was replanted in the second year to augment reseeding after an herbicide application prevented some of the planted species from reseeding. One of the two sites was mowed prior to sampling so no comparisons are attempted for that site. Data presented are for the D-10 site. The species present at the site are summarized in the table below.

Winter weeds were decreased in the cover crop plot versus the resident vegetation plot. Summer weeds were not different between plots. The mowing of the cover crop may have allowed additional growth of weeds.

Table 4.1. Plant species present at two walnut orchards owned by participants in the Walnut PMA program.

Deseret Farms	Plant Category	Gilbert Farms	Plant Category
Clover sp	F	Blando brome	F
Medic	F	Zorro fescue	F
Pink nitro	F	Burr clover	F
Crimson clover	F	California brome	F
White subclover	F	Clover sp	F
Blando brome	F	Yellow subclover	F
Vetch sp	F	White subclover	F
Annual bluegrass	WW	Chickweed sp	WW
Pineappleweed	WW	Wild oat	WW

brassbuttons	WW	Prickly lettuce	WW
Annual ryegrass	WW	Sheperdspurse	WW
Chickweed sp	WW	Annual bluegrass	WW
Henbit	WW	Common mallow	WW
Speedwell	WW	Filaree sp	WW
Annual brome sp	WW	Burr buttercup	SW
Common mallow	WW	Foxtail barley	SW
Sheperdspurse	WW	Thistle (Cirsium sp)	SW
Filaree sp	WW	Field bindweed	SW
Common groundsel	WW	Prostrate knotweed	SW
Burr buttercup	SW		
Annual crabgrass	SW		
Thistle (Cirsium sp)	SW		
Prostrate spurge	SW		
Foxtail barley	SW		
Scarlet pimpernel	SW		
Gallium sp	SW		
Common purslane	SW		

Plant category: F = forage, WW= fall or winter weed, SW = spring or summer weed.

Table 4.2. Fall and winter weed occurrences for cover crop versus no cover crop plots at Deseret.

Treatment	Fall/Winter Occurrence (%)	Spring/Summer Occurrence (%)
Cover crop	9 a ¹	11 a ²
No cover crop	29 b	22 a

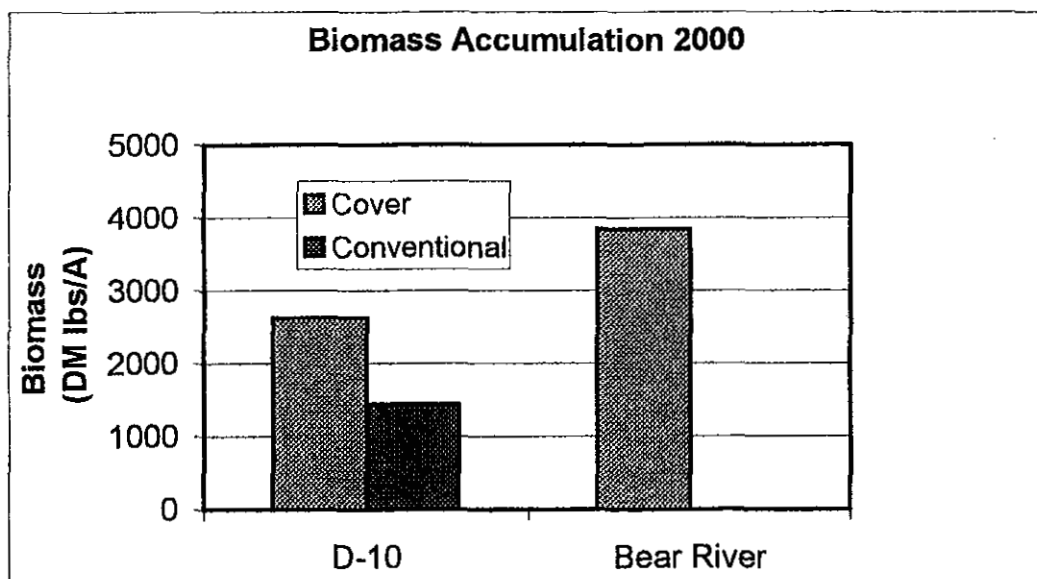
¹P=0.015

²P=0.22

The cover crop established well and reached maturity at both sites, allowing for reseeding of the cover crop. Weed frequency was lower in the plots with cover crops. In particular, buttercup was reduced dramatically in the Bear River orchard. Other species such as hairy fleabane were found at low levels in the unseeded plots but not found in the cover crop blocks.

Biomass was collected as discussed in 1999. Results were similar to the 1999 season in that the cover crop out paced the conventional by a two to one. The conventional was similar in production to the 99 season. The Bear River site cover crop yield was nearly the same as in 99 at 4000 lbs/acre. As previously mentioned the conventional was not measured in 2000.

Chart 4.4 Biomass Accumulation in 2000



Objective 5. Monitor for additional walnut pests: mites, aphids, and walnut husk fly.

Walnut Husk Fly

Three of the six statewide orchards monitored for walnut husk fly. Walnut husk fly monitoring occurred in Yuba, Butte, and Tehama counties. Traps were placed in May or June only in those orchards with a known population or a history of walnut husk fly. No insecticidal sprays were applied specifically for walnut husk fly in any of the orchards.

Walnut Aphid

Below, Table 5.1, are the season totals of walnut aphids detected in the orchards by treatments. No orchard required specific walnut aphid treatment. Starting on 6/1, walnut aphids were monitored weekly. The Lorsban treatments had considerably fewer mummies than the other treatments.

Table 5.1. Seasonal totals of walnut aphids detected Walnut PMA 2000.

	Grower Standard		Isomate C+/ Lorsban		Isomate C+/ Trichogramma		Isomate C+		Control	
	WA	WAM	WA	WAM	WA	WAM	WA	WAM	WA	WAM
Butte	95	133	95	99	225	227	246	290	169	226
Yuba	235	356	65	128	429	1186	348	847	86	140
Tehama	892	394	85	50	111	35	791	424	2	12
Fresno	73	82	NC	NC	NC	NC	107	127	NC	NC
Avg	291	237	83	92	255	483	362	411	86	126
Std	321	151	16	39	161	617	275	309	83	108

WA = walnut aphid

WAM = walnut aphid mummy

NC = Not collected

Dusky-Veined Aphid

Table 5.2 shows the season totals of colonies of dusky-veined aphid in four of the six PMA orchards. No orchard applied a spray to control dusky-veined aphid. The beneficial insects were able to control the dusky-veined aphid populations.

Table 5.2. Seasonal totals of colonies of dusky-veined aphid and beneficial insects, Walnut PMA 2000.

	Grower Standard		IsomateC+/ Lorsban		IsomateC+/ Trichogramma		Isomate C+		Control	
	DVA	B	DVA	B	DVA	B	DVA	B	DVA	B
Butte	0	40	0	37	5	71	5	58	0	62
Yuba	148	22	12	16	40	23	64	17	70	35
Tehama	4	16	0	4	0	5	0	35	0	0
Fresno	0	0	NC	NC	NC	NC	0	0	NC	NC
Avg	37	20	4	19	15	33	17	26	23	32
Stdev	74	17	7	17	22	34	31	24	40	31

DVA = dusky veined aphid

B = beneficial

NC = Not collected

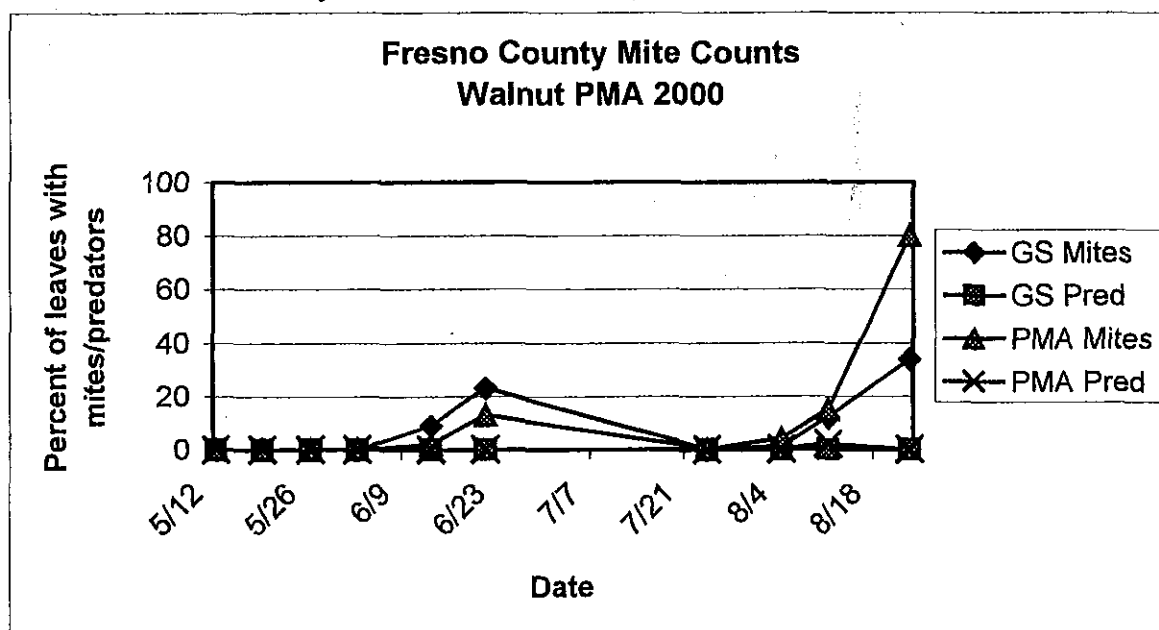
Webspinning Mites, European Red Mites, and Western Predatory Mite

Webspinning, European red, and western predatory mites were monitored in four of the Walnut PMA orchards. Fresno County sprayed a total orchard application of a miticide to control the population but proposed threshold levels were not reached. Yuba County required a miticide only in the Lorsban treatment. Butte County reached threshold levels in the Lorsban treatments but the grower decided not to spray and Tehama County did not require any miticide treatment.

Mite monitoring began in all orchards in May or early June. Monitoring occurred every week in most instances. Populations of webspinning mite and predatory mites were recorded as present or absent on leaves. Treatment decisions were based on the percentage of leaves infested. The numbers recorded below are the percentage of mite infested leaflets in the treatments.

Mites and predatory mites were monitored in Fresno County. Chart 5.3 shows the seasonal percentage of mites and predatory mites found in the grower standard and a PMA treatment that did not receive a pesticide application. Omite was applied to both treatments in June due to the rising populations of mites. The mite population then dipped, only to build again in August. No miticide treatment was applied due to the close proximity to harvest.

Chart 5.1. Fresno County Seasonal Mite Counts, Walnut PMA 2000.



The percentage of mites and predators found on the leaves in Yuba County are shown in Chart 5.2. The grower standard treatment did not receive an organophosphate spray, therefore the progression of an unsprayed treatment is shown. The predatory mites were able to maintain a low population of webspinning mites. However, in the two treatments receiving an organophosphate spray, the Isomate C+/Lorsban and the Consep/Lorsban, a miticide treatment was required. The mite population dropped dramatically following the miticide spray.

Chart 5.2. Yuba County Seasonal Mite Counts Walnut PMA 2000.

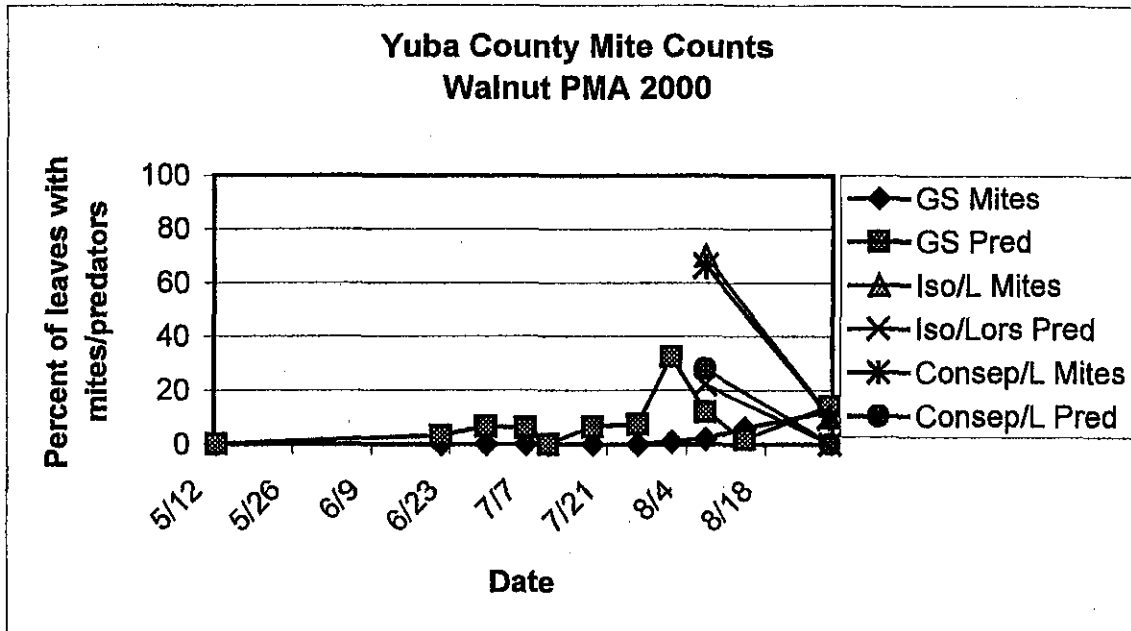
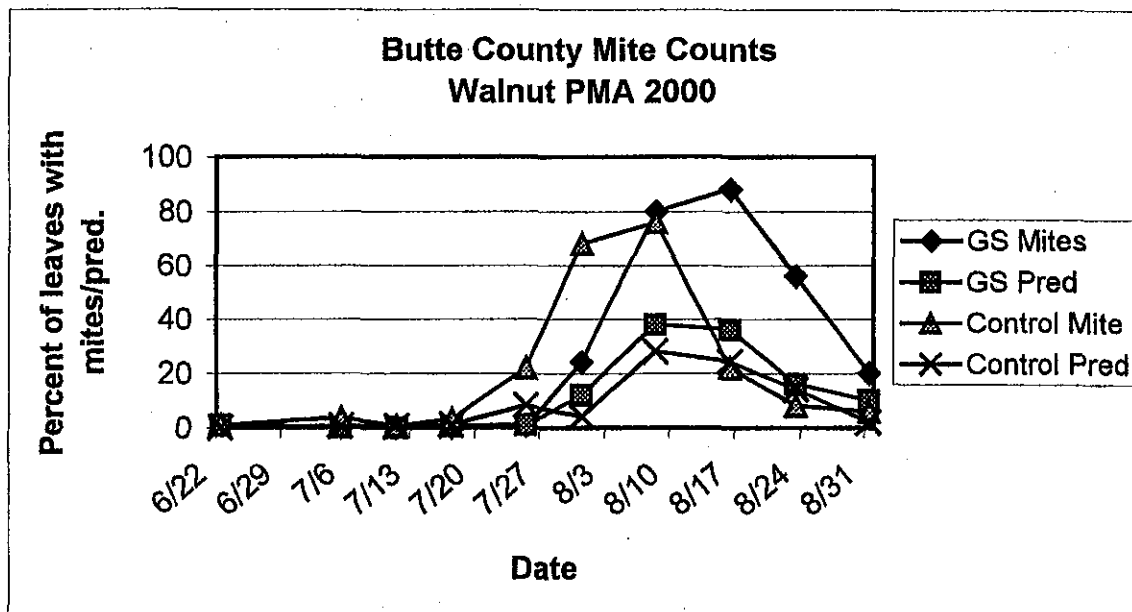


Chart 5.3 shows the seasonal counts of webspinning mites and predatory mites in the grower standard and the control treatments in Butte County. Despite the high number of mites, the predators were able to maintain control and no miticide was applied. However, the grower standard did receive an organophosphate spray and the mite population was substantially higher than in the control treatment where no organophosphate spray was applied.

Chart 5.3. Butte County Seasonal Mite Counts Walnut PMA 2000.



Mite monitoring in Tehama County detected no webspinning mite population and a very low population of predatory mites. Therefore, no miticide treatment was recommended. Despite applying an organophosphate in the grower standard, no mite population was detected.

Objective 6. Assess the economic impact of a reduced-risk program as compared to conventional practices.

For each of the seven orchards, the reduced risk costs are the same. The treatments in the reduced-risk treatments were: Isomate C+, Isomate C+ and *T. planteri*, and Isomate C+ and chlorpyrifos or tebufenozide. The Isomate C+ is a costly product and difficult to apply, but it is applied only once, at the beginning of the season. The Isomate C+ is currently approximately \$110.00 per acre for the material only and applied at a rate of 400 ties per acre, approximately eight ties per tree. Application of the Isomate C+ is tedious and labor intensive, requiring the use of towers in order to hang the product high in the canopy. The most experienced orchard, Yuba County, applied 15 acres of Isomate C+ with three workers in 10 hours. Therefore, to apply Isomate C+ to one acre would require one person 2 hours. The Isomate C+ was tied directly on the walnut tree branches and not on the clip in Yuba County. In Tehama County, the Isomate C+ was first tied onto clips and then the clips attached to the branches high in the canopy. This method required much more labor, people to tie the clips and then people to hang the clips. The Consep Checkmate XL-1000 is applied at a rate of 225 clips per acre at a cost of approximately \$110.00 per acre. To apply, the Consep Checkmate XL-1000, product took three men 3.5 hours to complete 10 acres. Therefore, it would require 1 hour to hang 1 acre of Consep. The treatment consisting of the Isomate C+ and *Trichogramma* consisted of eight aerial applications of *Trichogramma*. The treatment consisting of Isomate C+ and Lorsban or Confirm consisted of two sprays of the appropriate material. Costs for materials, labor, and machinery are shown below in Table 6.1

Table 6.1. Costs per acre for material, machinery, and labor in the Walnut PMA 2000.

Material	Machinery	Labor
Isomate C+ \$110.00/acre	Towers \$10.60/acre	\$7.00/hr
Consep or Checkmate \$110.00/acre	Airplane \$5.00/acre	
Trichogramma \$15.00/acre	Sprayer \$15.57/acre	
Chlorpyrifos \$44.30/gallon		

The cost of some mating disruption products may change as the products become more widely used. The costs for the towers and the sprayer were taken from "UC Extension Sample Costs to Establish a Walnut Orchard and Produce Walnuts, 1995". The cost of the airplane application was provided by Russ Stocker. The labor rates reflect the most recent federal minimum wage.

Table 6.2. Reduced-risk costs for the Walnut PMA 2000 (includes cost of application).

Treatment	Cost/Acre		Average Damage
Isomate C+/ Consep	\$135.00		1.22 % n=5
Isomate C+/ T. planteri	\$303.00		1.62 % n=5
Isomate C+/ 2 Sprays	Chlorpyrifos \$224.44	Tebufenozide \$266.88	0.32 % n=5
Checkmate XL-1000	\$135.00		1.2 % n=1
Checkmate XL-1000/ 2 Sprays	Chlorpyrifos \$224.44		1.2 % n=1

There was a wide variety of grower standard treatments. One grower applied nothing to control codling moth and one grower applied a wide variety of conventional products. Table 6.3 shows each grower standard costs, materials used, damage at harvest, and an overall average cost of a conventional program.

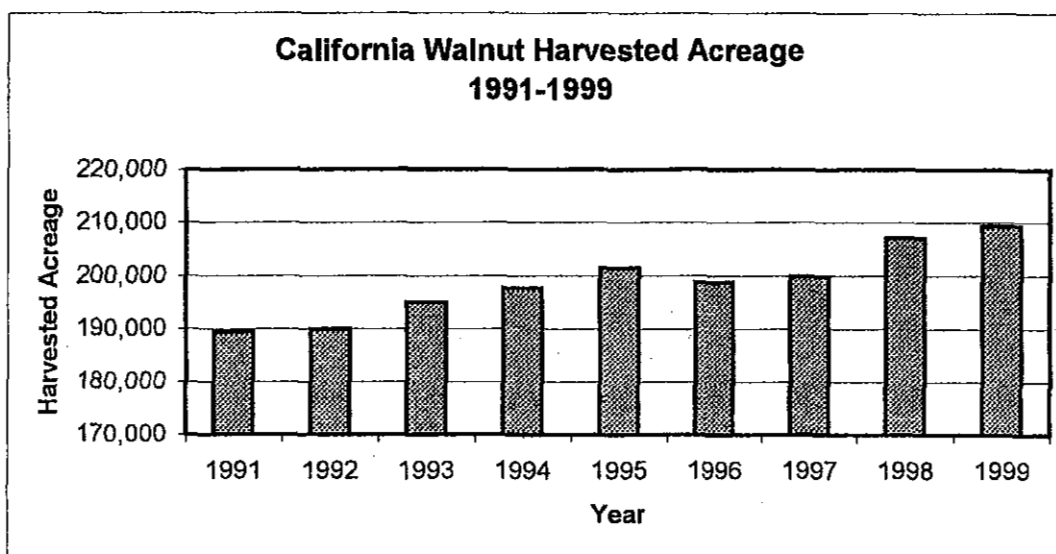
Table 6.3. Grower Standard treatment costs for the Walnut PMA 2000. Program cost per acre includes cost of application.

Orchard	Materials used	Program cost/acre	% Damage at Harvest
Fresno	Guthion (2x), Omite, Lorsban	\$117.30	0
San Joaquin- C	Lorsban, Guthion, Asana, Omite	\$100.76	0.1
San Joaquin- B	Lorsban (2x), Ambush (2x), Imidan (2x), Apollo, Asana	\$274.99	N/A
Yuba		\$00.0	4.6
Butte	Asana (2x), Lorsban	\$74.82	0.8
Tehama	Lorsban, Confirm, Activator	\$85.71	0.6
Average:		\$108.93	1.22 %

Objective 7. Record pesticide use in commercial walnuts over a 10-year period.

The results presented in this section were acquired from the worldwide web sites of the California Agricultural Statistical Service, UC IPM pesticide database, and the California Department of Pesticide Regulation Pesticide use Reports. Walnut acreage has increased in small increments steadily through 1991-1999. Over the past 10 years, harvested walnut acreage has increased. Chart 7.1 shows the walnut trend. Organophosphate, pyrethroid, and *Bacillus thuringiensis* usage is summarized in six walnut producing counties spanning from 1991 to 1999.

Chart 7.1. California harvested walnut acreage 1991-1999.



Organophosphate

The organophosphates used to determine the following were: azinphos-methyl, chlorpyrifos, diazinon, malathion, methidathion, naled, oxydemeton-methyl, phosalone, phosphamidon, and phosphamidon related products. A two-way ANOVA showed that there is no significant difference in organophosphate use per acre in the years spanning 1990-1999 ($p=0.12$), shown in Chart 7.2. There is a significant difference in the use of organophosphate per county as seen in Chart 7.4 ($p<0.05$). Below, Table 7.3, shows organophosphate use and walnut acreage in six counties in the years spanning 1991 through 1999.

Chart 7.2. Organophosphate use per acre in California 1990-1999.

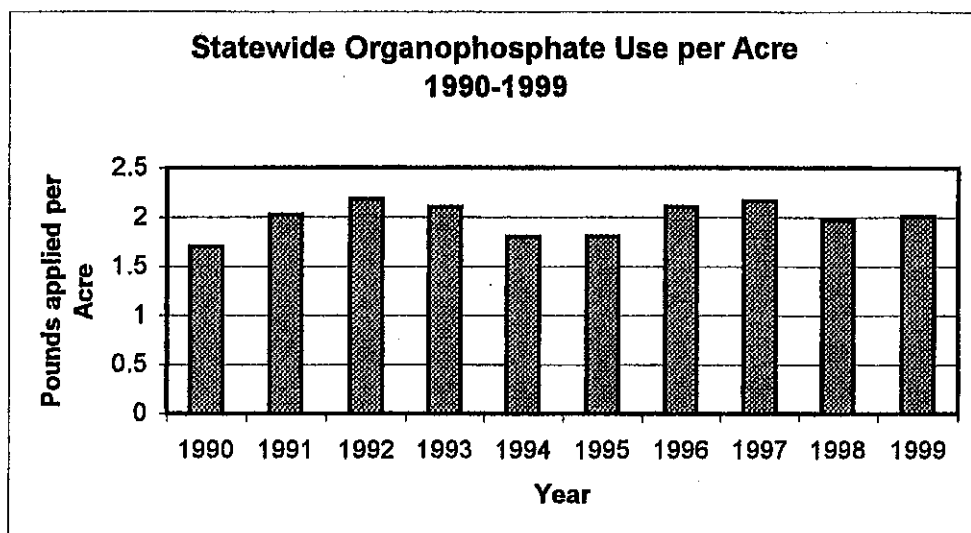


Chart 7.3. Average Pounds of OP applied per year in six walnut producing counties.

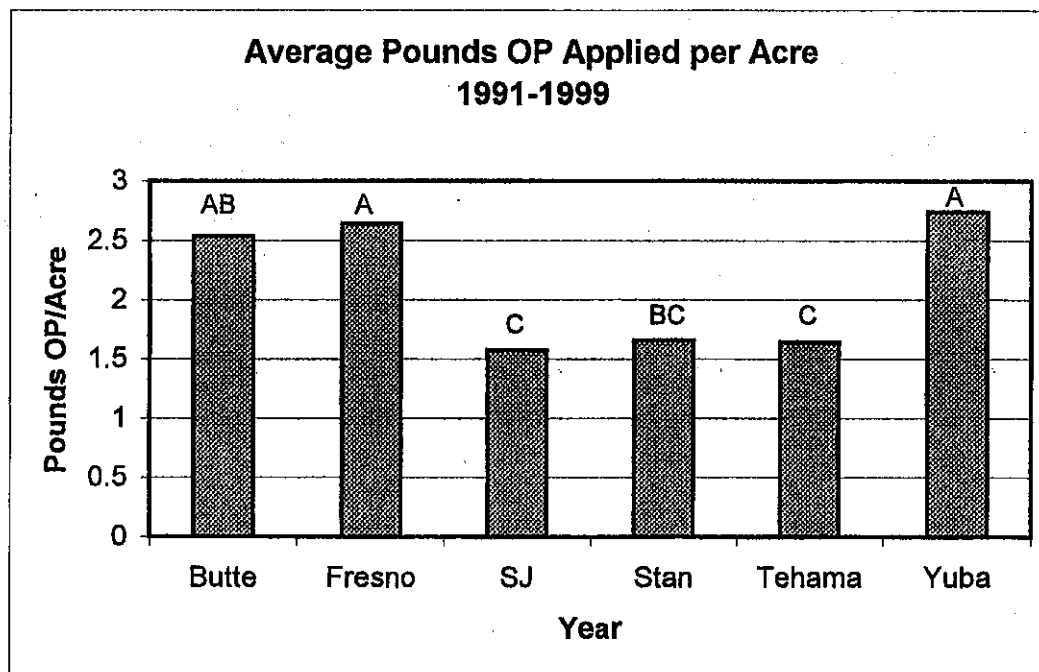
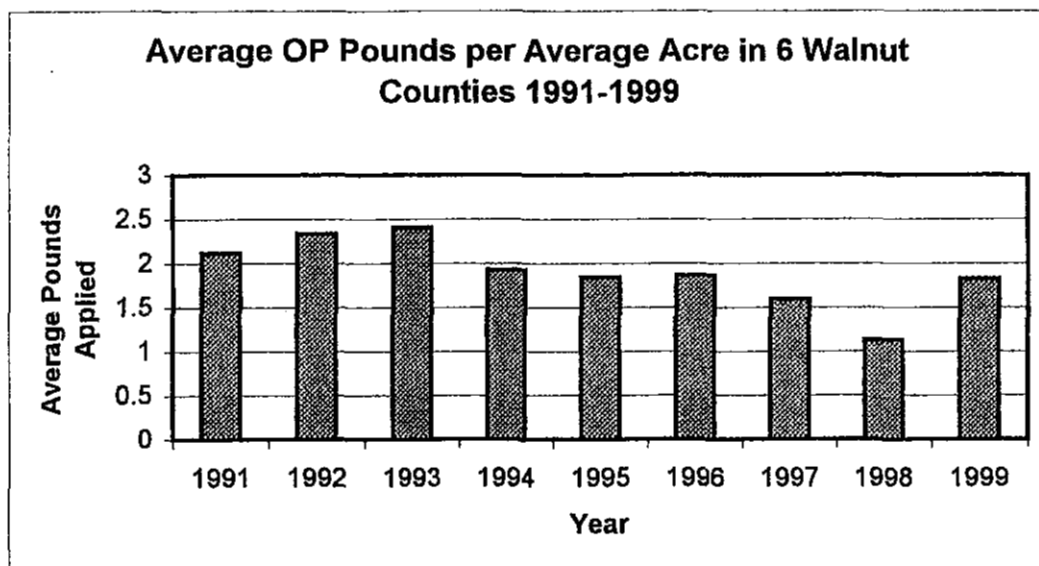


Chart 7.4. Average OP applied per acre in six walnut producing counties 1991-1999.

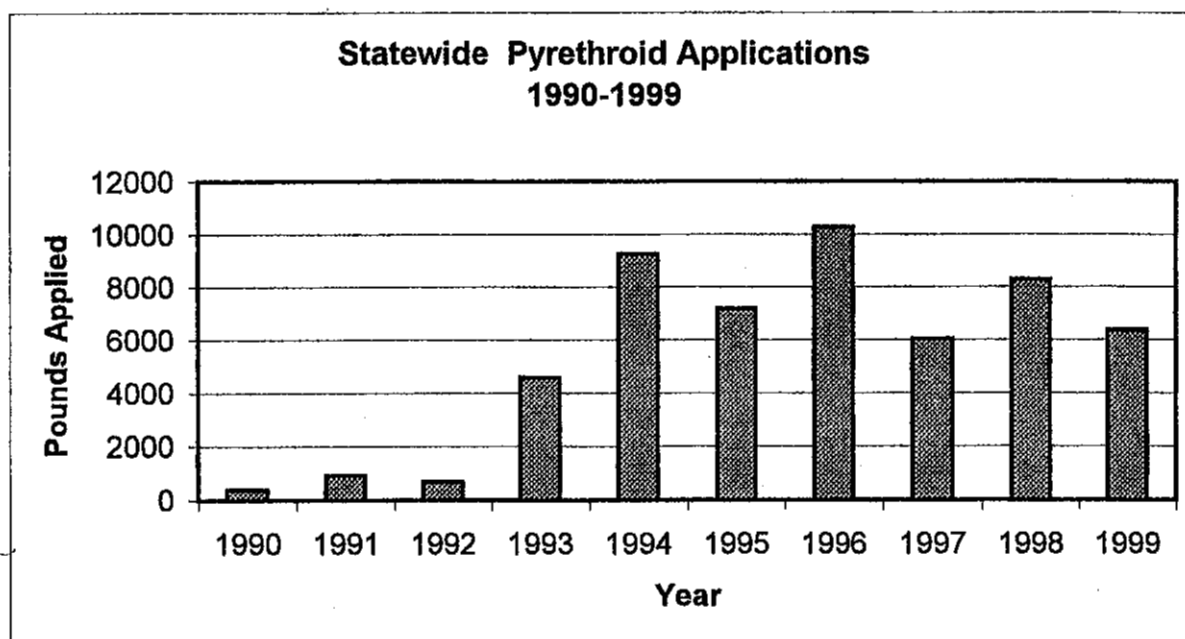


There is significant difference in the months the organophosphates were applied ($p < 0.05$). The months with the highest amount of pounds applied per acre are May, June, July, and August. This correlates with the flights of the codling moth. This shows that growers applying these products are doing so in a time where there is potential for economic loss due to codling moth.

Pyrethroid

Enfenvaterate, fenvalerate, permethrin, and related materials were the materials used in this section. These results were compiled using one-way ANOVA. In the six counties, there is significant difference in the use of pyrethroids applied per acre ($p < 0.05$). During the time period between 1991 and 1999, Butte County and Yuba County applied the most pyrethroids per acre. There is also a significant difference in the year in which the pyrethroids were applied the most ($p < 0.05$). The years of most use were 1994 and 1996. However, in 1999, the amount of pyrethroids applied per acre dropped. The months of application are broader when using pyrethroids. For organophosphates, the months of application are very defined and significantly different ($p < 0.05$). However, pyrethroids are used more consistently. Beginning in April and ending in September, pyrethroids are applied.

Chart 7.5 Pounds of pyrethroid applied in California.



Bacillus thuringiensis(Bt)

Despite the fact that in 1991 when Bt was virtually not applied, there is no significant difference in Bt usage in the time span ($p=0.24$). However, in 1995 and 1996, Bt usage spiked and then fell again. There was another increase in Bt application in 1999. There is no significant difference in the month in which Bt is applied ($p=0.89$) although the peak months of application are April, May, June, July, and August. Again, these application timings reflect the cycle of the codling moth and redhumped caterpillar. However, since the use of Bt is low and the variance is high, there is no significant difference.

Chart 7.6 Average pounds of Bt applied in the years from 1991-1999.

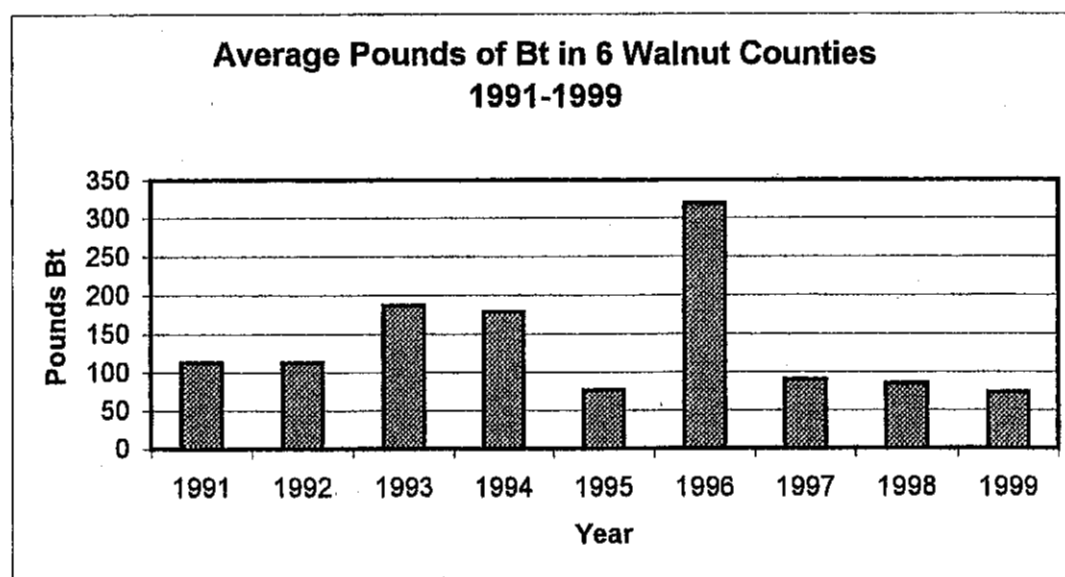


Chart 7.7. Average pounds of Bt applied per acre from 1991-1999.

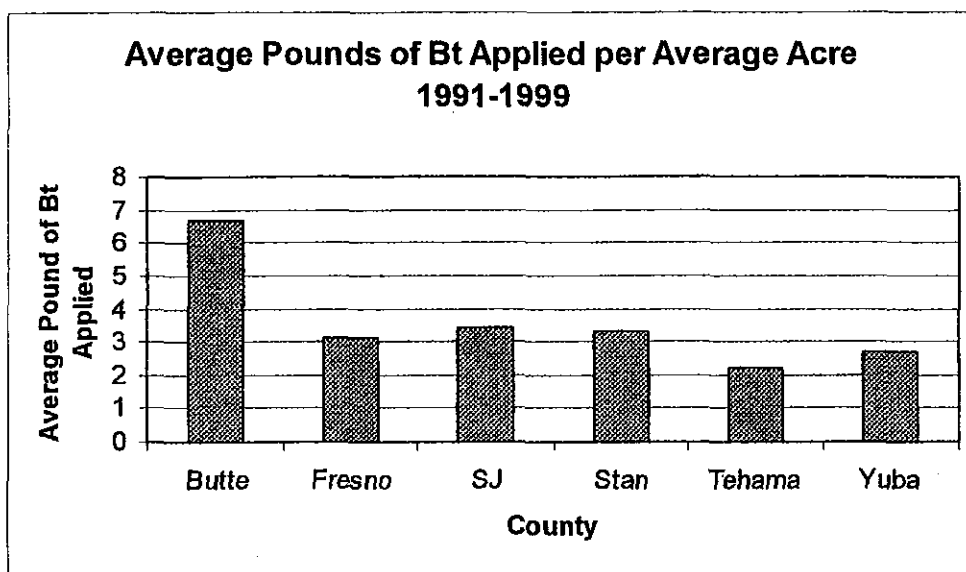
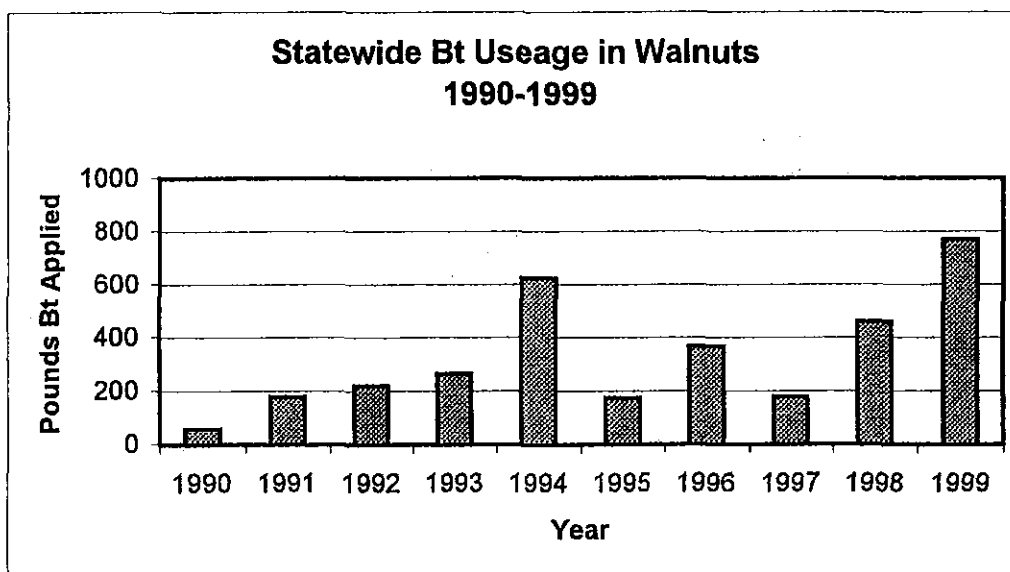


Chart 7.8. Total pounds of Bt in walnuts used in California.



DISCUSSION

The Walnut PMA is not solely for demonstration but has now shifted its focus to a statewide reduced risk research and implementation project. Attempting to include a control program for all of the pests that commercial walnut growers face is a large task. The codling moth control component was successful. To a large extent, codling moth was controlled using pheromone technology. However, long-term effects of a pheromone alone treatment have not been researched, and results should be viewed with discretion. As demand for the pheromone product increases and the supply increases, then the product may become more economically feasible for growers. Given some ingenuity, a more efficient pheromone application method, and solid

research, this product may be more easily accepted on a large scale. All treatment blocks were under 2.5% codling moth damage at harvest. Whereas the treatment of Isomate C+ and Lorsban showed the most control, the Isomate C+ alone and Isomate + *Trichogramma* were also encouraging for implementing reduced-risk strategies since they provided the same control as the grower standard. The blight project had very little blight to evaluate this year. The lack of rainfall this spring resulted in very little walnut blight, making evaluations difficult. We will be asking cooperating growers to continue working with us on evaluating this treatment in 2001 and will expand the blight treatments to include the blight model. We will be expanding the cover crop objective next season. We will expand reduced risk strategies for next year, building upon knowledge learned from this year.

SUMMARY AND CONCLUSIONS

The objectives of the Walnut Pest Management Alliance are to comply with the FQPA regulations set in 1996 that may severely limit or ban traditional chemicals used to control pests in commercial walnuts. The Walnut PMA made great strides in Year 2. The accomplishments are:

- Mating disruption materials have shown to provide the same or better codling moth control across the state.
- Mating disruption research has shown that a sprayable pheromone treatment can be incorporated into the codling moth demonstration sites in the oncoming season.
- Replicated treatments statewide allow for statistical methods to be applied.
- Built a positive relationship with growers who allowed an unsprayed control treatment in their commercial crops.
- Blight research has developed a blight forecast model that will be incorporated into the PMA demonstration sites
- Cover crops were shown to provide a viable option for weed management and reducing pesticide runoff

Obstacles within the PMA project are:

- Mating disruption as a means of control requires labor intensive monitoring.
- The PMA project's Weed Specialist accepted another position out-of-state, and therefore the weed management cover crop component may be more difficult to study. However, Terry Prichard will continue with the run-off, irrigation requirements and nutrient cycling component of cover crops.
- Reduced risk required more intensive monitoring for all primary and secondary pests. These more intensive sampling is necessary to develop information for optimizing monitoring to determine pest levels and spray decisions.
- The weather did not provide the correct environment to adequately examine blight control.

The Walnut PMA benefits the walnut industry, the University, the walnut grower, and the environment. Through this program, we built a large cooperative group dedicated to educating growers and PCAs about reduced-risk practices, mating disruption technology and track economic data relating to conventional versus reduced risk practices.

A continuing benefit is the PMA Management Team. The Team is involved in the PMA not only by sponsoring meetings but by attending field meetings whenever possible. By having a

presence at field meetings reinforce the support for reduced-risk practices and that the Walnut Industry is an important member of the PMA.

Growers have been eager to learn at the field meetings and have turned out in great numbers. The field meetings provide useful information regarding farming issues. Growers have responded positively to the statewide field meeting

Thus far, the Walnut PMA has formed partnerships with growers who are proactive and interested in reduced-risk farming practices. We have shown that damage levels are acceptable with implementing a reduced-risk program on a small but growing amount of acreage in three vastly different walnut growing regions. Overall, the Walnut PMA has been successful and is showing great promise for reduced-risk farming.

REFERENCES

- Buchner, R. P., W. H. Olson, C. Pickel, C. Gilles, and N. Bertagna. 2001. Walnut Blight Control Investigations. Walnut Research Reports 2000, Walnut Marketing Board, pp. 359-370.
- Light, D., K. Reynolds, J. Grant, J. Groh, C. Pickel, N. Darby, T. Prichard, M. Rego, J. Hasey, W. Bentley, B. Ribeiro, R. Buchner, W. Olson, A. Knight, S. Lingren, and B. Campbell. 2001. Advances in Development of a Monitoring and Management System for Codling Moths Based on a Novel Female and Male Attractant Kairomone. Walnut Research Reports 2000, Walnut Marketing Board, pp. 207-241.
- Lindow, S. E., B. Teviotdale, R. Buchner, W. Olson, G. S. Sibbett, R. Beede, A. Haxo, J. Legac, and L. Light. 2001. Epidemiological Approaches to the Control of Walnut Blight Disease. Walnut Research Reports 2000, Walnut Marketing Board, pp. 303-327.
- Mills, N. J., W. Bentley, T. M. Bezemer, R. Buchner, W. Olson, C. Pickel, W. Reil, and G. S. Sibbett. 2001. Importing Parasitoids for Area-wide Management of Codling Moth in Walnuts. Walnut Research Reports 2000, Walnut Marketing Board, pp. 269-277.
- Mills, N. J., T. M. Bezemer, E. Julier, and J. Grant. 2001. Walnut Susceptibility to Codling Moth Damage: Cultivars and Orchards. Walnut Research Reports 2000, Walnut Marketing Board, pp. 279-289.
- Welter, S. C., F. Cave, and M. Singleton. 2001. Development of Alternative Pheromone Dispensing Technologies for Management of Codling Moth. Walnut Research Reports 2000, Walnut Marketing Board, pp. 165-205.

APPENDIX A

**CALIFORNIA WALNUT COMMISSION SUMMER, FALL, AND WINTER REPORTS,
2000-2001.**



CALIFORNIA WALNUT COMMISSION

SUMMER REPORT

1999-2000

June 2000

WALNUTRITIOUS



**A HANDFUL OF
WALNUTS A DAY
KEEPS THE
CARDIOVASCULAR
RISK AWAY**

*A new study presented at the Clinical Hospital of
Barcelona, in conjunction with the
University of Barcelona & Loma Linda University*

Until now, the Mediterranean diet has been seen as one of the most beneficial when it comes to preventing cardiovascular disease. However, a study carried out at the Clinical and Provincial Hospital of Barcelona has reached an interesting conclusion: the benefit is even greater if a handful of walnuts is added to the diet in place of other ingredients. The study was conducted in conjunction with researchers from the University of Barcelona and from Loma Linda University, California.

The study was published on April 4 of this year in the prestigious medical journal, *The Annals of Internal Medicine*, and it was presented to the media on the same day in Barcelona. The presentation was made by the leaders of the medical team that carried out the study, namely Dr. Daniel Zambón and Dr. Emilio Ros, from the Lipids Section of the Clinical Hospital, and Dr. Juan Carlos Laguna, from the Pharmacy Department of the University of Barcelona.

The press conference was well-attended by representatives of the media, including the main Spanish press agencies for general information, the largest daily newspapers, and the majority of national, regional, and local radio and television stations. The event also generated a lot of interest among the health and lifestyle press. For several days following the press event, the media followed up with interviews of the authors of the study.

Surprising Results

The Barcelona study has shown that adding walnuts to the Mediterranean diet yields an estimated 11% reduction in the

risk of heart disease; each reduction of cholesterol by 1 mg/dl is equivalent to a 1% reduction in cardiovascular risk. According to the researchers, this benefit could be even greater if walnuts were added to the typical diet in western countries, in place of foods heavy in saturated fats, such as butter, cold cuts, pastries, and so on. It is just these saturated fats that drive up cholesterol levels.

The study was carried out with a group of 49 men and women between the ages of 28 and 72, all with high blood cholesterol levels. For six months half of the participants in the study followed a classic Mediterranean diet, in which olive oil was the main source of fat. At the same time, the other half of the volunteers ate a similar diet, except that walnuts—from 8 to 10 per day—replaced a part of the olive oil and other fats. Thus, the two diet plans were differentiated only in terms of the composition of the fat element.

As expected, the Mediterranean diet reduced the cholesterol levels significantly. Nonetheless, this reduction was heightened with the addition of walnuts. Cholesterol was reduced 11 mg/dl (4.1%); LDL, or 'bad' cholesterol, was down by 5.9%; and lipoprotein (a), another element containing harmful blood cholesterol, was lowered by 6.2%.

According to Dr. Ros, the research team leader, the investigators viewed the results of the study "as a pleasant, even incredible, surprise, since we expected that the effects of the two diets we were studying on cholesterol of the



Dr. Laguna, Dr. Ros and Dr. Zambón at the Barcelona press conference.

asked to implement a soft chemical or pheromone program for the first generation and supplement with soft chemicals or *Trichogramma* for later generations. In several cases during this first year, the codling moth population was too high and the populations were not lowered enough in the first generation. This allowed the population to cause damage at harvest or in the following season. Using a known pheromone product that has been successful in other crops and an organophosphate pesticide for the first generation will assure the success of the transition to mating disruption by lowering the codling moth population. This technique will carry less risk of potential damage for the grower and the PMA project.

Data from the first year of the PMA project is difficult to interpret and cannot be summarized across geographical areas. This makes it necessary for the PMA project to develop a more comprehensive demonstration program that standardizes treatments, with an untreated check at each demonstration site. All treatment blocks will be five acres except for the control, which will be from one-quarter to one-half acre in size. The following tables are a list of the treatments that will be used in orchards with high codling moth populations and those used in orchards with low codling moth populations.

High Codling Moth Population Orchards	
Treatment 1	Pheromone + OP
Treatment 2	Pheromone
Treatment 3	Pheromone + <i>Trichogramma</i>
Treatment 4	Grower Standard
Treatment 5	Control

Low Codling Moth Population Orchards	
Treatment 1	Pheromone + Confirm
Treatment 2	Pheromone
Treatment 3	Pheromone + <i>Trichogramma</i>
Treatment 4	Grower Standard
Treatment 5	Control

The pheromone product used will be Isomate C+ because it has been extensively researched in apples and pears and has become the standard used by both industries. Isomate C+ requires one application per year and is known to last 140

to 150 days in California. In the high population orchards, the organophosphate Lorsban will be applied for the 1A and the 1B flight. This treatment will transition high population blocks into a reduced-risk program with two Confirm applications in the second year of the program. The low population orchards will receive two applications of Confirm over the course of the growing season in the first year. The orchards in Fresno and Tehama, both in the PMA last year, will use the Confirm treatment.

In the treatments that receive *Trichogramma*, the wasps will be applied aerially during the second and third codling moth generations. The grower standard will vary with each orchard, and the control block will not receive any treatment. This untreated check will be incorporated into the grower standard on the edge of the orchard and must be at least 100 meters from the pheromone application in order to avoid pheromone drift from the treated areas. An additional five-acre block treated with the pheromone product Consep and a block of Consep plus organophosphate has been added to the Yuba County PMA site.

Weekly monitoring for codling moth will continue in all of the demonstration orchards using protocols refined by the management team with Dr. Steve Welter and Dr. Doug Light. Trap monitoring in the PMA mating disruption blocks includes a 1x trap hung low and a 10x trap hung high in each five-acre PMA treatment block. The grower standard and untreated check will have a 1x low and a 1x high. Each treatment will have a trap with a bisexual plant volatile lure. This new experimental lure will tell us about male and female flights as well as percent of mated females. It will help tell us how well the mating disruption is working and will improve monitoring. The Walnut PMA feels this emerging scientific technology will provide us with a better monitoring tool that will greatly aid the adoption of pheromone technology, since it will easily show growers whether pheromones are providing control.

The damage evaluations will use five trees for each block and will include seasonal nut drop per tree for the first generation, canopy counts for the second and third generation, and a 500 nuts/treatment harvest sample. Economic analysis of each codling moth treatment will be determined, so that growers will know the costs of the programs as well as how well they worked. Secondary pests and beneficials, including walnut aphid, dusky-veined aphid, mites and key mite beneficials, and walnut husk fly will be monitored using standardized monitoring protocols developed by the management team with Area UC IPM Advisor Carolyn Pickel and UC IPM Entomologist Walt Bentley.

UC WALNUT SPECIALIST POSITION FILLED



The Department of Pomology has announced the selection of Dr. Bruce Lampinen to fill the statewide walnut specialist position vacated originally by the retirement of David Ramos in 1996, and again last year by the subsequent retirement of Warren Micke. "Persistence and patience has paid off," according to David Ramos, WMB Research Director, "we feel very fortunate to have someone of Bruce's caliber and background as our new walnut specialist."

In addition to coordinating statewide extension activities involving walnuts and almonds, Dr. Lampinen will be developing a research program in integrated orchard crop management systems. He is already very experienced in a number of California tree fruit crops and industries, and has a proven track record of outstanding research and extension in his current Cranberry Experiment Station position at the University of Massachusetts.

Dr. Lampinen completed his doctoral research under Dr. Ken Shackel in the UCD Department of Pomology in 1997. His dissertation, supported by the California Prune Board, was "Effects of Regulated Deficit Irrigation on Prune Tree Physiology and Productivity." He showed that moderate levels of regulated deficit irrigation based on plant water potential measured with the pressure bomb can result in substantial water savings while maintaining or enhancing dry prune yields and quality, and improving drying ratios. As a result of his work, prune farm advisors and growers are now expanding the use of tree water status measurements as a basis for irrigation scheduling.

After leaving Davis in March 1998, Dr. Lampinen assumed the position of Assistant Professor, University of Massachusetts Cranberry Experiment Station, where he established himself as a cranberry water management expert. As part of his work, he was able to resolve a serious industry-wide problem of over-irrigation and fruit rot. Dr. Lampinen's experience covers a wide range of Pomological research including nitrogen fertilization, use of growth regulators, and problems associated with bloom, fruit set, fruit sizing, and vegetative growth. He should be a valuable addition to the walnut research program, especially in addressing problems related to canopy management and plant-soil-water relations.

Dr. Lampinen will be assuming his new assignment in late summer and he will be visiting farm advisors and growers to become oriented to the needs of the walnut industry. Please take advantage of the opportunity to become acquainted with Dr. Lampinen.

PMA PROJECT LAUNCHES YEAR TWO

By Molly Espley

During its first year the Walnut Pest Management Alliance (PMA) project achieved many important accomplishments. Three regions launched demonstration projects under the guidance of the management team. These demonstrations provided useful monitoring and economic data for the project and growers. We organized several well attended field days and the California Walnut Commission newsletter featured updates about the project. The knowledge we gained during the first year of the project has prepared the Walnut PMA team to implement a large-scale reduced-risk program. In addition to these accomplishments, we learned several valuable lessons during the first year of demonstration:

- Team management and communication are first and foremost for coordinating a successful project.
- Growers are eager for knowledge and will attempt a variety of reduced-risk practices if knowledge is to be gained.
- Growers will actively participate in application of materials and meetings.
- Reduced-risk practices can work in some orchards.
- Orchards and monitoring techniques require standardization to gain the most information.

We will put these lessons into practice during 2000 by making some changes to the Walnut PMA project. The codling moth management results from the first year have shown that pheromone mating disruption is the most promising technique for successful reduced-risk programs. Research funded by the Walnut Marketing Board in the early 1990s showed that mating disruption could be an effective pest management alternative. This practice has proven successful in apples and pears, however, the practical use of mating disruption is not fully understood in walnuts. An objective of the PMA will be to identify under what conditions this practice is most effective.

Walnuts pose new challenges in pheromone implementation, especially in regard to tree canopy volume. Walnut trees are large, and filling the entire canopy with pheromone is often difficult. For this reason, the demonstration orchards will include orchards of the Vina or Ashley variety, with trees no higher than 35 feet tall.

The typical practice in walnuts is to ignore the first generation of codling moth and then apply pesticides for later generations. In 1999, Walnut PMA growers were

The number of demonstration sites will be reduced from twelve to seven cooperators, in order to ensure proper monitoring and better communication within the team. The cover crop trials established in 1999 will be followed, even though the codling moth and blight demonstration sites have been relocated. These sites will focus on cover crop establishment and management and will be monitored for biomass and weed species competition. The sites will also demonstrate the multiple benefits of a planted cover crop for nutrition and water infiltration, providing habitat for natural enemies, keeping dust down, reducing off-site movement of insecticides, and weed competition.

The Walnut PMA will continue to focus on demonstrating resistance management and reducing fungicide applications to manage walnut blight. Promising results from small scale plots by Jim Adaskaveg, Rick Buchner, Bill Olson and Steve Lindow will be demonstrated in the reduced-risk demonstration sites. These potential reduced-risk management options for walnut blight include:

1. The use of silicon penetrator surfactants at bud break to eradicate overwintering walnut blight. Small research plots have shown a 50% reduction of blight sprays when using this program. Although 1999 was a low blight year, there was less blight in the PMA blocks using Breakthru as a bud break spray.
2. Bud sampling to determine population dynamics of the pathogen and develop predictive models for disease development based on early season population counts. The field scouts have collected samples and a lab analysis is being conducted to determine inoculum levels and copper-resistant blight. This information is being used to determine the best blight program to follow in the PMA block.
3. Ensuring good spray coverage by testing spray equipment and applying fungicides every row. Spray coverage is also critical to the soft chemical programs for codling moth.

Blight evaluations will be taken in late May to early June by collecting a 100 nut sample from 10 trees per treatment and examining for incidence of blight. Reducing blight damage will also help reduce the need for navel orangeworm sprays.

Developing proper irrigation management practices will continue to be an objective of the PMA project. To maximize yield and quality and reduce mite outbreaks in walnut orchards with cover crops, it is important to allow for the increased water use of the cover crop. Proper irrigation management can also help reduce sunburn, which in turn minimizes navel orangeworm damage and the need for navel orangeworm sprays. The PMA project plans to develop a computer-generated irrigation model as a tool for

irrigation scheduling, which can be demonstrated at field meetings.

Field meetings will continue this year, with at least two meetings to be held in each region at the PMA demonstration sites. Techniques - such as the use of degree-days and traps, estimating populations of beneficial insects and monitoring aphids, mites and walnut blight - will be demonstrated. These meetings will also discuss how to use alternative practices for codling moth management, including mating disruption and *Trichogramma*. In addition to field meeting announcements, look for updates about the project in this newsletter and local farm advisor newsletters. Another goal for this year will be to post information about the project to a Web site that will be hosted by the Walnut Marketing Board.

UC DAVIS PRESENTS ENDOWMENT AWARD

Mr. Michael Campbell, Assistant Dean of the College of Agricultural and Environmental Sciences at the University of California at Davis, presented the Walnut Marketing Board with a one-of-a-kind artwork, a glass-etched walnut tree, in recognition of the Board's vision and leadership in establishing the David E. Ramos Walnut Research Endowment.

The endowment assures continuous walnut breeding research and permanently links the California walnut industry with the expertise of the Pomology Department at UC Davis. Mr. Campbell said, "This endowment shows strong leadership and support for the University by the walnut industry. A binding partnership and permanent source of funding has been established. On behalf of the University, I thank the Board for all they have done."

Mr. Earl Lindauer, Chairman of the Research Committee, graciously accepted the artwork on behalf of the walnut industry. He emphasized the endowment was a part of the ongoing work of many people and will help support our partnership with the University. The award was then given to Dennis Balint, Executive Director of the Walnut Marketing Board, to be displayed at the Board's office.

The endowment was started in 1994 and funded by the Board at \$200,000 a year for five years until completely funded in 1998. At the end of last year's marketing year, July 31, 1999, the value of the fund reached \$1,134,828. In 1996 the endowment was named after Dr. David E. Ramos in recognition of his many years of dedicated service and leadership to both the University and the walnut industry.



CALIFORNIA WALNUT COMMISSION

FALL REPORT

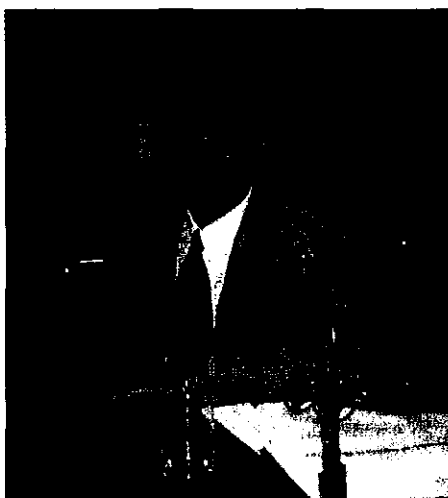
2000-2001

OCTOBER 2000

BARCELONA WALNUT TRIAL ROUNDTABLE A BIG HIT IN BONN

As part of the continuing public relations effort for the Barcelona Walnut Trial published in the *Annals of Internal Medicine*, the Market Development Committee directed the Commission staff to plan roundtable discussions in several of our export markets. The purpose of these discussions is to target the medical and scientific opinion leaders in an effort to have articles written about the Barcelona study in various medical and scientific trade journals. The nutritionists, doctors and medical professionals who read the articles can then tell their patients about the health benefits of walnuts. Although it may seem like a rather indirect route to reach the consumer, it is an excellent way to add credibility to our health message.

The first of these roundtable events was held in Bonn, Germany on August 19. Dr. Joan Sabate, who traveled from Loma Linda University for the event, started the roundtable discussions with a vivid presentation of the Barcelona research and explained the results. Several German scientists interested in this area of health and nutrition research followed him.



There was excellent attendance with over 25 press members attending from national nutrition and medical media.

After these talks the press asked some excellent questions which led to intensive discussions. In addition to those who attended, press kits highlighting the event were released to journalists throughout Germany.



Press Members at Roundtable Discussion in Bonn

The Commission staff is pleased with the results of this roundtable. We eagerly await the results which we will see in the form of press clippings this fall. We are hoping for similar success at events in Spain and Canada in the spring of 2001.

CWC SCORES WITH MAP! RECEIVES ALLOCATION INCREASE

In June 2000 the CWC received \$2,285,000 from the Market Access Program (MAP) in support of our export marketing activities for marketing year 2001. This represents a 4% increase from the previous year's allocation. Significant portions of the CWC's marketing activities are funded through the Market Access Program (MAP), a program administered by USDA's Foreign Agricultural Service (FAS).

This is the first year where MAP applications were graded or ranked. FAS looks at five key factors when evaluating each application: overall quality of application, grower contribution, value of exports, administration, and the country progress report. The CWC ranked eighth of the 34 applicants in the Horticulture and Tropical Fruits Division where walnuts and other nuts are covered. Thanks to the guidance of the committee, our strengths were in the area of our total application quality (ranking 2 of 34) and grower contribution (ranking 3 of 34.) Because of this good performance, we received an increase in funding. Other groups that ranked lower received no increase or a cut in funding.

WALNUT PRODUCTION RESEARCH

Twenty-six research projects for 2000/2001 representing a total budget of \$654,455 were approved by the Walnut Marketing Board at its fall meeting on September 8. The review process started with the presentation of 32 research proposals at the 32nd annual Walnut Research Conference held in Bodega Bay on January 26-28, 2000. Participants in the conference were walnut farm advisors, researchers, and members of the WMB Research Committee. Subsequent to the conference, a technical advisory committee reviewed the proposals and provided their analyses to the WMB Research Committee which met in March and again in July to develop its recommendations to the Board.

Nine of the 26 projects are new and provide additional reinforcement in addressing the problems with codling moth, crown gall, *Phytophthora*, and the potential loss of methyl bromide. The programmatic allocations of the 2000/2001 research budget are as follows:

<u>Program Area</u>	<u>No. Projects</u>	<u>Budgeted Amount</u>
Cultivars/rootstocks	5	\$159,659
Codling moth	5	137,500
Walnut blight	3	101,842
Crown gall	3	86,419
Horticulture	3	50,468
Phytophthora	2	47,677
Nematodes	2	38,490
Postharvest	<u>3</u>	<u>32,400</u>
	26	\$654,455

The following is a brief synopsis of some of the 2000/2001 walnut research projects.

Varieties/Rootstocks

Nine new selections were identified by growers, handlers, nurserymen, and farm advisors at the annual crackout meeting held by Dr. Gale McGranahan and Chuck Leslie at Davis in May. With the 12 promising selections made in 1999, this brings the total number of seedlings from the breeding program that appear to have the potential for new cultivar releases up to 21. Selection criteria for advanced testing is based primarily on early harvest date, shell traits suitable for inshell, kernel quality, and yield potential.

Currently, there are over 6000 seedlings being grown from controlled crosses which started in 1990. As additional seedlings come into bearing, they are initially evaluated for two years for their nut characteristics. Graft wood is then collected from the most promising ones and used to

propagate trees that are planted in selection blocks at CSU-Chico, the Kearney Ag Center near Parlier, and UC Davis for further evaluation.

There are four research projects coordinated by Jim McKenna that are associated with developing improved rootstocks. They are extensions of the Paradox Genetic Diversity Study (PDS) which began four years ago. Nearly 4000 trees, comprising over 30 paradox seed sources supplied by 12 major walnut nurseries, are currently being field evaluated in four orchard trials in Tehama, Yolo, San Joaquin, and Kings counties. At the same time, these seed sources are being screened under controlled inoculation conditions for resistance to root lesion nematode, *Phytophthora*, and crown gall. Also, several outstanding individuals were selected from among these seedling populations and are being reproduced clonally by micro propagation for further testing as potential clonal rootstocks.

An increasingly important adjunct to the breeding program is the work in biotechnology under the direction of Dr. Abhaya Dandekar. Up until recently, this research involved inserting single genes and creating transgenic plants with insect and disease resistance. Several of these are under field evaluation.

The direction of the program is now moving from single genes to working with gene networks. This is the exciting new field of genomics involving gene/trait discovery which has the potential to enhance our ability to diagnose and provide genetic solutions to productivity and quality problems and to enhance nutritional quality and extend shelf-life of walnuts. The tools of genomics and genetic engineering provide us the opportunity to discover new useful genes in walnuts and by utilizing the existing walnut transformation program, to modify their behavior.

The initial strategy is to look at how oil is made in walnuts, at the genes that are involved in converting saturated and monounsaturated fatty acids to polyunsaturated fatty acids (Omega 3 and Omega 6), and at rancidity. Since much is already known about the biochemistry of oil composition and quality in walnuts and other plants, it lends itself as an ideal model system to develop genomics in walnut. This is cutting-edge technology and gives our industry a competitive edge over the long term.

Codling Moth

Codling moth is arguably the most important problem in walnuts at the present time. It now represents better than 20% of our research budget and has received more than \$600,000 in WMB research funding over the past 10 years. At the same time, DPR pesticide records show increasing use of OP's, monitoring/spray timing is becoming more

difficult, and cross resistance to insecticides including IGR's is an added complication.

The walnut PMA is designed to demonstrate and encourage the adoption of alternative reduced-risk pest management methods with codling moth obviously the key pest. We have a number of reduced-risk control tactics available including (1) introduced parasitoids, (2) *Trichogramma*, (3) IGR's, (4) Bt, and (5) mating disruption for relatively small sized walnut trees. Unfortunately, mating disruption is the key and new technologies for delivering pheromones into orchards are needed for implementation into most walnut orchards.

This year, we were able to enlist the support of Dr. Steve Walter from UC Berkeley to undertake a research project on "Development of Alternative Dispensing Technologies for Management of Codling Moth." He is the person who coordinated and was largely responsible for the widespread adoption of pheromone mating disruption as the primary control for codling moth in pears. He recognizes that the high rates of dispensers per acre that have proven effective in pears would be prohibitive for the taller walnut trees. Also, issues of higher background densities of codling moth in walnuts, differences in walnut orchard and canopy structure, and potential interactions with other insect pests make the direct transfer of technologies developed in pears more questionable.

Alternative dispensers that Steve is evaluating are sprayable microbead formulations, paraffin emulsion, and aerosol emitters (puffers). Preliminary results from trap catches and canopy counts in his research trials are very promising. If damage assessment at harvest confirm the effectiveness of these alternative pheromone delivery technologies, plans are to develop them for wide spread usage and integrate them into the PMA orchard sites next season.

Several other research projects complement the mating disruption work in attempting to develop alternative strategies for the control of codling moth. Dr. Doug Light, USDA-ARS, Albany, CA, is evaluating a host plant-derived volatile chemical lure that attracts both male and female codling moth. The use of this lure can provide information needed on the emergence and density of female moths in the orchard, whereas pheromone traps only catch male moths. A monitoring tool that can validate an alternative model of female emergence and mating would likely improve our management of codling moth.

Dr. Bob Van Steenwyk (UC Berkeley) is cooperating with

Steve Welter on a study to develop a CM resistance management strategy for walnuts using negatively correlated insecticides. This is particularly important since research has demonstrated that CM has the potential to develop resistance to the new IGR insecticides as well as cross resistance as a result of repeated use of Guthion.

Dr. Nick Mills (UC Berkeley) has been collecting, importing, and releasing specialized parasitoids from the region of origin of the CM from Central Asia since 1992. This is the final year of the project and he has successfully established two out of the three key parasitoids in walnut orchards throughout the state in collaboration with walnut farm advisors. He feels they will reduce the regional pressure from CM and become an important component in the development of effective integrated pest management programs.

When you match our WMB research projects with the PMA program under the direction of Carolyn Pickel, Walt Bentley, Terry Prichard, and cooperating walnut farm advisors, we have an incredible array of talent and resources directed at codling moth. We are confident that we will make these alternative strategies for controlling CM work. It's becoming increasingly clear, however, that we must prepare ourselves for two additional concerns: monitoring CM and secondary pests. One of the conclusions drawn thus far from the PMA program is that extensive monitoring is essential for reduced-risk practices to be successful. This increased capability/expertise among growers and PCA's will need to be developed. We can expect the emergence of secondary pests (e.g., walnut husk fly) as a result of the reduced use of hard chemical insecticides. These problems will require research attention as we incorporate alternative approaches to controlling codling moth.

Postharvest

As part of our search for methyl bromide (MB) replacements for postharvest fumigation of walnuts, especially involving inshell shipments to Europe, a new research project entitled "Application of Radio Frequency Treatments to Control Insects in Walnuts" was initiated this year. The project leaders are Dr. James Hansen, USDA-ARS, Wapato Washington, and Dr. Beth Mitcham, UC Davis. It involves the use of radio frequency (RF) emissions which are currently used by the food processing industry to process baked goods and for moisture control and post-baking drying of food products.

RF use on walnuts is based on the premise that codling moth larvae and other insects react stronger to RF and heat faster than the walnuts and that a very rapid treatment is feasible. It looks like it would be possible to design a continuous RF

treatment process to treat large amounts of walnuts in a short period of time, and it may offer several added advantages. RF could provide quick drying of bleached inshell walnuts. There also is a suggestion that it might enhance shelf life and reduce rancidity potential by reduction of lipase activity. Furthermore, it's a non-chemical approach as opposed to other proposed alternatives to MB fumigation.

PMA PROJECT FIELD DAY FOCUSES ON CODLING MOTH

Molly Johnson, BIOS Program Assistant

We met at Chiappe Farms in Farmington for a Walnut Pest Management Alliance (PMA) field day on August 30. Despite the unseasonable weather, almost 100 people gathered to hear an update on the PMA project. This was a statewide field day co-sponsored by the San Joaquin Walnut BIOS Project.



The audience listens as Bob Elliott discusses DPR's role in the PMA

The PMA was developed in 1998 with funding from the Department of Pesticide Regulation (DPR). The PMA is a demonstration project to expand and strengthen current efforts to develop and implement alternative reduced-risk pest management strategies in walnuts statewide. One focus of the project is to minimize the use of organophosphate insecticides to control codling moth. The program also demonstrates alternatives for walnut blight management and addresses the use of herbicides, cover crops, nitrogen and water.

Overall management and responsibility for the PMA is under the direction of the Walnut Marketing Board (WMB). Additional participants include Community Alliance with Family Farmers (CAFF) Biologically Integrated Orchard Systems (BIOS) Project, UC Cooperative Extension Farm Advisors and Specialists, Agricultural Experiment Station Researchers, UCIPM

Advisors, Pest Control Advisors (PCAs), walnut growers and insectaries. The project has received a third year of funding and will continue through 2001. A proposal for fourth year funding will be submitted in November and, if approved, will allow the project to continue through 2005.

The field day started with brief introductions from the cooperators. Dave Ramos and Dennis Balint discussed the WMB's role and why they support the project. Bob Elliott discussed DPR's reasons for funding these alliances that have been formed in several different crops. BIOS Program Assistant Molly Johnson discussed CAFF's participation in the project. To conclude the introductions, San Joaquin County Farm Advisor Joe Grant discussed the efforts he is coordinating between the San Joaquin Walnut BIOS Project and the PMA.

Walt Bentley, Entomology IPM Advisor, gave an overview of alternative codling moth control methods. The alternatives currently available are mating disruption, an insect growth regulator (Confirm), and releases of the codling moth parasitoid *Trichogramma*. There are several mating disruption products available, but the PMA is using Isomate. The PMA is currently evaluating all of these alternatives with five treatments in each cooperating orchard. The treatments are: 1. Isomate, 2. Isomate/*Trichogramma* 3. Isomate/Grower Standard 4. Conventional 5. Control. Yuba County orchards have additional treatments that include another mating disruption product, Consep. The grower standard varies depending on the codling moth population. In low population orchards, two applications of Confirm are applied in addition to Isomate. For orchards with high codling moth populations, an organophosphate application is made during the first generation in combination with Isomate. The conventional treatment also varies by orchard. For example, the conventional treatment at Chiappe Farms is an application of Lorsban for the first generation followed by an application of Guthion combined with Asana and Omite later in the season.

Steve Welter, UC Berkeley Entomologist, talked in more detail about mating disruption. He has worked extensively with mating disruption in apples and pears and would like to develop a mating disruption program for walnuts that would be effective for at least 25% of the walnut acreage. Some of the current obstacles to more widespread use of mating disruption are the current cost as well as the delivery method. Mating disruption materials are currently in the form of hand-applied dispensers and work is being done to develop different delivery systems that may be sprayable, dispersed in a puffer, or applied aurally. The PMA is also conducting studies to determine how long the materials last in the orchard. Another critical factor will be defining

monitoring techniques to go along with mating disruption.

Nick Mills, Biological Control Specialist from UC Berkeley, was going to discuss his research with Trichogramma, but he was not able to attend. However, Russ Stocker from Arena Pest Management was on hand to discuss his role in the PMA project, making aerial releases of Trichogramma. Releases of 200,000 eggs per week for four weeks are made during the second and (in some orchards) third generation of codling moth. The eggs are dispersed with a substance that helps them stick to the leaves and provides them with a food source after they emerge. The PMA is evaluating the impact of these releases on codling moth.

Monitoring is an essential component of the PMA and Jeannine Groh, UCCE Field Scout, discussed how she monitors walnut orchards for pests and beneficials. The orchards are monitored weekly for codling moth, mites, aphids, and beneficial insects. When monitoring for codling moth, she records trap counts and degree day accumulation in order to give an idea of the population and generation timing. In addition, the number of dropped nuts are recorded and canopy counts are conducted in order to assess damage. The participating growers receive this information from their orchard weekly.

Sacramento Area IPM Advisor Carolyn Pickel discussed management considerations for using alternative codling moth control methods. She emphasized that monitoring is the key to reduced risk programs. Then she reviewed trap types and the trapping protocol for the PMA blocks. In the pheromone blocks, 1x traps are placed low and 10x traps are placed high. The 10x traps should not be used in non pheromone treated orchards; therefore, in the grower standard and the control blocks 1x traps are placed both low and high. Her discussion stressed that when using traps for threshold assessment, you need to use the same trap type year after year. If you change trap type, you can not build up a history from that block. In order to catch the most moths in a low population orchard, use the stickiest trap that has a flap.

Pickel reminded growers that it is important to monitor the canopies for codling moth. Canopy counts can be done at the end of each generation to make a decision for the next generation. Look at a minimum of 100 nuts per tree on 5 trees. If you have two percent damage you will need to spray the next generation. Canopy counts can also be done in the middle of the generation at 500 degree days to make sure everything is okay.

The field day concluded with a panel of growers and industry representatives discussing their experiences with

alternative codling moth control methods. During this discussion it was agreed that there is a need for economic incentives for growers to reduce pesticide use. Growers involved in the PMA and San Joaquin County Walnut BIOS Project expressed their enthusiasm for the projects and hope to learn more about how they can effectively implement reduced-risk pest management strategies.

The PMA would like to thank everyone involved in the coordination of this field day and those who were able to attend. We look forward to future field days with more updates on the project.

"MAKING THE CLAIM FOR NUTS"

On September 20, 2000, Georgetown University's Center for Food & Nutrition Policy and the International Tree Nut Council sponsored a scientific conference entitled "Making the Claim for Nuts". The conference was held at Georgetown University in Washington D.C.

The conference was designed to bring together participants from science, government (USDA, FTC, FDA), researchers, dietitians, academicians, food industry representatives, consumer advocates, and public policy makers to examine the scientific evidence regarding the health benefits associated with nuts. The conference also focused on how nuts fit in to the U.S. consumer eating patterns and discussed policy implications of the structure/function and/or health claims regarding nuts. Dr. Christine Lewis of the FDA was the luncheon speaker and she attempted to provide some insight as to how FDA regards *health claims* as well as the so called "*structure function claims*".

This activity enabled the tree nut industry to showcase the various research findings. Researchers discussed the role of nuts in relation to heart disease, cancer and weight control. Dr. Penny Kris-Etherton, PhD, RD of Penn State University said, "When included in the diet, the fatty acids, vitamins, minerals and phytonutrients contained in tree nuts may interact synergistically to produce marked health benefits."

Walnuts are unique in that they are a good source of the all important omega-3 fatty acids. The *Loma Linda Walnut Trial* which was published in the *New England Journal of Medicine* on March 4, 1993 and the *Barcelona Walnut Trial* which was published in the *Annals of Internal Medicine* on April 4, 2000 have established the fact that walnuts, as a part of a healthy diet, can lower cholesterol, one of the risk factors for heart disease. And as Dr. Joan Sabate of Loma Linda University has stated on many occasions, "It is practical and easy to incorporate walnuts into the everyday diet."



CALIFORNIA WALNUT COMMISSION WINTER REPORT

2000/2001

February 2001

NEW CREATIVE CONCEPTS DEBUT AROUND THE WORLD

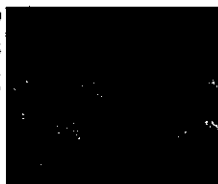
The Barcelona Walnut Trial, published in April 2000, has had a tremendous impact worldwide. The consumer and trade response to the positive health message has been excellent. We want to build on the strength of this message in all of our marketing programs. In the current marketing year we have created new advertising campaigns in Spain, Germany and Japan that reinforce this health message to both consumers and members of the trade.

In Spain, where the study took place, we have a new television campaign. In this market, television has been used for several



years as it is the most effective way to reach our target audience. This year our advertising message focuses on one of the key concepts of the study: "A handful of walnuts a day will lower your cholesterol".

The campaign uses two ten-second advertisements. These short ads allow us to reach more of our target audience more frequently while staying within the current budget. In the first ad, we see a closed fist. The hand opens to reveal a handful of walnuts. As this happens, the announcer says, "Reducing cholesterol...is in your hands." Then there is a cut to the California Walnut Quality Seal, and the announcer says "California Walnuts. A handful a day."



The second ad is a scene of a business lunch in a restaurant. The smart young man at the table pulls out a handful of walnuts to sprinkle on his salad. There is a slight look of suspicion from the



other diners and then a knowing glance. The voice over is the same and the ad finishes with the same final shot of our quality rosette. Although it is difficult to imagine a television advertisement, the spots are very clever and the simple execution allows for clear health message.

The Barcelona Walnut Trial also had a significant impact in the German market. This year our campaign has three key message points: California origin, health and versatility.

Appearing in both women's publications and billboards, three new print ads were developed. The first ad ran during the Christmas season to support the traditional inshell market. It showed a vignette of a Hollywood premier and a traditional Christmas lamb dish using walnuts. The headline read "'Take One', for the Walnut".



The second ad will run in the winter months. It shows a delicious fish entree with a vignette of the Golden Gate Bridge. The headline reads "More Walnuts with Fish". In Germany, it is common to use a play on words and in this case the same headline could read "Sea Walnuts with Fish". Interestingly, the word for "more" and "sea" in German are the same.

The final ad headline reads "California Tastes So Crunchy". Again, this is a play on words as the German word for crunchy can also mean "crisp" and also "tone". The ad shows a light, crisp salad with walnuts and a vignette of a healthy young woman rollerblading.



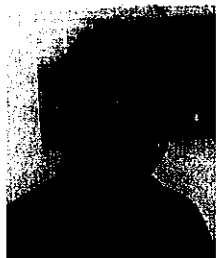
In each print ad the body copy focuses on the "good" fat message and staying fit and healthy with California walnuts. The magazine ads also contain a coupon for our German recipe brochure. These coupons are coded so that we can track which magazine had the greatest response rate.

In Japan, we are also focusing on the health benefits of walnuts and continuing to build on the ancient tradition of eating walnuts for better health. Our Japanese agency, MK Netmark, has produced similar ads for both the trade and consumers to convey a consistent image for California walnuts. The three ads use historical figures such as Cleopatra, Leonardo da Vinci and Atlas to convey the message of how California walnuts can help maintain your beauty, your brains and your brawn because they are so nutritious.

Our other programs in Israel, Italy, Korea, and Canada also use the results of the Barcelona study and the "handful-a-day" concept in their in-store promotions, tie-in programs and public relations. This powerful message will have a long life around the world.

CURRENT AND FUTURE DIRECTIONS FOR MANAGEMENT OF CODLING MOTH IN WALNUTS

Stephen Welter,
Division of Insect Biology, U.C. Berkeley, CA



Several phenomena have resulted in an increased research emphasis on management of codling moth including a) the documentation of resistance in codling moth to some commonly used insecticides b) the development of newer technologies such as pheromone mating disruption for control c) a progressively increasing need to help cut production costs, and d) development of new, more selective insecticides that help provide control without disruption of naturally occurring biological control. While this article expresses my personal views, it actually details the efforts and interests of a much larger group including UC Cooperative Extension, UC/IPM, and other UC faculty. As such, I have tried to outline our current research efforts as well as a sense of our future directions such that growers might better understand how the University of California in collaboration with the Walnut Marketing Board is attempting to resolve some very serious issues in walnut pest management. Many of the following programs are predicated on these assumptions: management of codling moth will need to be developed in the context of the larger IPM program including navel orangeworm, walnut husk fly or mites; future IPM programs will need to address public and government concerns; and any new IPM program must place walnut growers in a stronger economic position.

There are two main thrusts currently in walnut IPM development: 1) the Pest Management Alliance (PMA) that consists of growers, UC Cooperative Extension, UC/IPM Specialists, and the Walnut Marketing Board and 2) more individualized research programs funded by a variety of sources. The most recent additions to the funding pool are funds from two federal programs that will contribute approximately \$4 million dollars to fund research on building more selective programs for codling moth in both pome fruit and walnuts. These funds were awarded in part because of the existence of on-going research and commitments from the various commodity groups in the western US.

The PMA projects and campus based research efforts have now started to be interwoven in more complete and structured ways. The PMA programs have the task of attempting to implement our best management programs and to test and demonstrate research programs that are near-term. As such, the PMA program in 2000 met all objectives including demonstrating that control of codling moth with pheromone mating disruption was feasible, documenting that combination programs of pheromone and a single insecticide application proved superior on average to conventional programs,

understanding the relative value of additional supplemental programs of *Trichogramma* releases, and finally that a new codling moth lure from a plant volatile could monitor codling moth flights accurately in pheromone permeated orchards. Simultaneously, research at UC Berkeley was investigating other pheromone dispensing technologies as alternatives to hand-applied dispensers that would be logistically more feasible, decrease overall cost of the program, and increase program flexibility. As an example of the integration between research groups, results from the research in 2000 on new technologies are being integrated into the PMA for 2001 as one of the treatment programs.

Research in 2001 will have many of the same emphases, but will build on the datasets collected in 2000. Specifically, two newer delivery technologies look very promising in terms of their ease of use and potential cost savings. These newer technologies include: a) Sprayable formulations of microencapsulated codling moth pheromone by two different companies, 3M and Consep, b) Aerosol emitters ("puffers") that are being produced or developed by several groups, "Paramount Puffers", Consep puffers, or Michigan State Microsprayers.

The first step in the development process for the sprayable formulations was to determine their longevity and abilities to suppress pheromone traps for codling moth. Based on residual analyses and trap suppression of constantly released sterilized codling moths, the sprayable formulations in walnuts appeared to last at least 80 days and provided trap suppression at levels equal to or superior to the standard Isomate C+ treatments. Equally positive, high levels of trap suppression at almost all rates examined suggested that application rates could be reduced dramatically, thus potentially reducing costs. Mapping of pheromone plumes from aerosol emitters suggest that the area of influence of a single puffer may reach in excess of 1500 ft downwind and laterally 200-300 feet in either direction. An additional finding was that the plumes have a residual nature that appears to last for 24-72 hours after the puffers are turned off. This finding would suggest that the plumes do not have to constantly bathe a moth directly, but instead have only to have resided in the area within the past 24 hours.

Research for 2001 will now need to focus on suppression of nut damage rather than trap suppression. Previous research has clearly provided examples where traps are suppressed, but damage is not. The most conservative treatment with the sprayable formulation will be incorporated into the PMA projects, while more aggressive treatments will be tested in experimental plots in terms of longevity, application rates or puffer distributions.

A second major direction has to be building a program that embraces the entire complex of pests including navel orangeworm. Obviously, some species of pests should prove less problematic as more effective biological control agents already exist, e.g. the walnut aphid or spider mites. However, inclusion of softer insecticides to suppress moderate to high

populations of codling moth will need to consider our needs for other species that most likely will not be suppressed by biocontrol agents, e.g. walnut husk fly. So, the current emphasis cannot be on developing an insecticide free management program, but rather on management strategies that maximize our use of existing natural enemies, integrate non-insecticidal but cost-effective alternatives such as pheromone mating disruption, and include the minimal use of highly selectively insecticides as supplemental suppression tools.

Alternatively, the long-term goal has to be construction of a self-sustaining system that relies heavily on biological intensive management wherever possible. Therefore, it is essential to develop economically and logistically reasonable alternatives that are viewed as safe for the public and the environment, before current strategies are removed by either biological or legislative changes.

WALNUT PEST MANAGEMENT ALLIANCE CONCLUDES YEAR TWO WITH POSITIVE RESULTS

Molly Johnson

The end of this year marked the completion of the second year of the Walnut PMA project. The objectives of the second year were to continue to focus on reduced risk techniques with an emphasis on standardizing the treatments statewide. By building from the positive responses from the first year, the PMA continues to showcase economic pest control and pushes forward to develop monitoring techniques.

To standardize the treatments for this project that spans from Fresno to Tehama counties, the number of orchards participating in the project was reduced to six and limited to those with trees under 35 feet in height. Although the project has objectives that address several aspects of orchard management, a primary focus of this year's research was to determine the effectiveness of mating disruption to control one of the industry's most challenging pests, codling moth. The treatments in the cooperating orchards were as follows:

Isomate C+
Isomate C+ and <i>Trichogramma platneri</i>
Isomate C+ and Lorsban or Confirm
Grower standard
Untreated control

Each treatment block was approximately five acres with the exception of the untreated control that was approximately one acre. Isomate C+ is a mating disruption product that is applied by hand shortly after biofix at the rate of 400 ties per acre. Lorsban or Confirm was applied during the 1A or 2A flight or as deemed necessary by the farm advisor. Lorsban was used in orchards with a monitoring history of high codling moth populations and Confirm was used in orchards with low

codling moth populations. *T. platneri* was aerially applied once per week for four weeks during the second generation and once per week for four weeks during the third generation. The eggs are applied at a rate of 200,000 per acre. The grower standard was the growers' normal farming practices, which typically includes the use of organophosphates and pyrethroids.

This year the project was able to demonstrate effective reduced risk strategies for controlling codling moth. To a large extent, codling moth was controlled successfully using only pheromone mating disruption. Damage levels at harvest were less than 2.5% in all the treatment blocks that received Isomate C+ alone. Whereas the treatment of Isomate C+ and Lorsban showed the most control, the Isomate C+ alone and Isomate C+ and *Trichogramma* were encouraging as reduced risk alternatives. A major obstacle to the widespread adoption of hand applied pheromone mating disruption products is the cost. However, as demand for the pheromone product increases and the supply increases, then the product may become more economically feasible for growers.

Monitoring

The demonstration orchards are monitored extensively throughout the season. Monitoring is an essential component of a reduced risk system. The goals of the PMA project are to promote monitoring as well as refine current monitoring techniques. Each orchard was monitored weekly from biofix to harvest using traps and visual observation.

Five trees were selected at random in each treatment and monitored throughout the season for signs of codling moth damage. The overwintering generation was monitored by nut drop, subsequent generations were monitored by canopy count, and the final evaluation was a harvest sample collected from the windrow prior to pickup. Nut drop and canopy counts are tools to aid in determining the amount of damage after each respective generation. The damage at harvest is the way to determine efficacy of each treatment.

Blight and Cover Crop Evaluation

In addition to researching and demonstrating reduced risk strategies for controlling codling moth, the PMA is also charged with evaluating reduced risk strategies for other pests that commercial walnut growers face. The walnut blight component was inconclusive this year. Because of the lack of rainfall during the spring of 2000, there was low incidence of walnut blight. One of the goals is to develop a predictive model for blight occurrence, but the evaluation will have to continue for several years to fully measure its reliability and impact.

Cover crops are being evaluated in two of the demonstration orchards in Yuba County. Each orchard contains a planted cover crop treatment and a native vegetation treatment. One cover crop was manually reseeded in the winter of 1999 and the second cover crop was allowed to reseed naturally. Biomass and species counts were assessed from both orchards in both treatments in May 2000.

Walnut PMA 2001

As the project enters year three the plan is to continue to evaluate the effectiveness of pheromone mating disruption to control codling moth. The project will use the hand tied dispensers as well as evaluate some new technology. A new sprayable pheromone has been developed, but the product has not been widely tested and is not yet commercially available. The PMA project will incorporate this product as a treatment. The components evaluating other pests as well as the cover crop evaluation will continue unchanged.

The Walnut Pest Management Alliance has been active in implementing reduced risk practices and updating farm advisors, field scouts, pest control advisors and growers through its outreach tools. We look forward to the upcoming year and have been awarded funding for a fourth year (2002). Continue to watch for updates in this newsletter as well as fliers advertising field days that will be scheduled during 2001.

EVERY CHAD COUNTS IN ELECTING YOUR BOARD AND COMMISSION REPRESENTATIVES

This year the Walnut Marketing Board and California Walnut Commission are holding elections for members and alternates for the next two-year term, 2001/2003.

We invite all growers and handlers to consider running for the positions available. We would especially like to encourage eligible women, minorities and those with disabilities to consider serving as a member or alternate. Participation of new individuals will result in new ideas and enhance our overall effort. Now is the time for members of the industry to play an active role in electing the individuals that will represent them on the Board and Commission, said Mr. Dennis A. Balint, Executive Director of the Walnut Marketing Board and CEO of the California Walnut Commission.

Following are the specifications for each election. If you have any questions please feel free to call the WMB/CWC office at (916) 646-3807.

WALNUT MARKETING BOARD

Under the regulations of the Federal Marketing Order, 10 members and 10 alternates will be selected by the Secretary of Agriculture. The Secretary will select the Board members and alternates from the nominees elected by the industry.

For the 2001 election here is a list of available member and corresponding alternate positions:

- Two cooperative handlers
- Two independent handlers
- Two cooperative producers
- Two independent producers (one from each district)
- One independent grower at-large
- One public member (nominated by the nine elected members)

The cooperative positions are appointed by the Diamond Board of Directors. Independent growers and handlers will elect their nominees through the following process.

In March the petition forms will be mailed to all independent walnut growers. It takes 10 or more independent growers who marketed an aggregate of 500 tons or more of walnuts in the 1999/00 marketing year through independent handlers to place a grower's name on the ballot.

Ballots will be mailed to independent growers and handlers in April. Independent handlers can vote for incumbents or they can write-in the names of new candidates. The election results will be announced in July.

CALIFORNIA WALNUT COMMISSION

Every two years the Commission law provides for the nomination of 13 members and 13 alternates that will be appointed by the California Secretary of Food and Agriculture.

Here is a list of the member and corresponding alternate positions:

- Four independent producers (two from each district)
- Four cooperative producers
- One independent producer/handler
- One cooperative producer/handler
- One independent handler
- One cooperative handler
- One public member (nominated by twelve elected members)

Similar to the Walnut Marketing Board election, the Diamond Board of Directors will appoint the members and alternates for their positions.

All independent growers or handlers participating in the election must complete a nomination form in order for their name to appear on the ballot. These forms will be mailed in May. Independent producer and independent producer/handler candidates must return the form with at least 15 eligible independent grower signatures. For the producer positions the signatures must be from the growers in that district. Independent handler candidates must submit a petition with at least 5 other independent handler signatures.

In July independent growers and handlers are mailed ballots to cast their vote. The election results will be announced in late August.

District 1: Counties in the state that lie north of a line drawn on the south boundaries of San Mateo, Alameda, San Joaquin, Calaveras and Alpine counties.

District 2: Consists of all other walnut producing counties in the state south of this boundary line.

APPENDIX B

***WALNUT RESEARCH REPORTS, 2000* “WALNUT PEST MANAGEMENT ALLIANCE
2000: YEAR 2 UPDATE”.**

WALNUT PEST MANAGEMENT ALLIANCE 2000 - YEAR 2 UPDATE

Management Team: C. Pickel, W. Bentley, T. Prichard, W. H. Olson, R. Buchner, J. Grant, T. Prather, M. Johnson, and B. Elliott

Cooperating Farm Advisors: J. K. Hasey, W. H. Olson, R. P. Buchner, W. H. Krueger and M. Freeman

Regional Field Scouts: N. Darby, M. Goff, and B. Ribeiro

Cooperating Researchers: Steve Lindow, Steve Welter, and Nick Mills

ABSTRACT

The Walnut Pest Management Alliance (PMA) was established with the funding provided by California Department of Pesticide Regulation (CDPR) in 1998 to develop a statewide broad-based demonstration and implementation project designed to encourage adoption of reduced-risk pest management programs in commercial walnuts. The PMA is a cooperative group effort that includes the University of California research and extension, walnut growers and industry, Biologically Integrated Orchard Systems (BIOS), and pest control advisors. In the second year of the Walnut PMA, the program continues to promote reduced-risk products and to improve communication and cooperation among the groups involved. The Walnut PMA projects evaluates reduced risk strategies for codling moth, *Cydia pomonella*, blight, *Xanthomonas campestris*, cover crop, and assesses the economics of implementing a reduced risk program. These efforts attempt to control the economic damage of pests by implementing reduced risk practices. The Walnut PMA codling moth research project included six early cultivar walnut orchards ranging from Fresno to Tehama county. Blight was evaluated in the dormant season and again in late May to determine damage levels. The cover crops were assessed in the spring to determine reseeding and survival. The economics show the adoption cost of these programs. Growers have not readily adopted these reduced-risk alternatives because these practices are perceived as high risk and more expensive than using conventional broad-spectrum insecticides. Reduced-risk programs require multiple years of implementation in order to gain the confidence of commercial walnut growers. The performance of reduced risk techniques requires a commitment and teamwork so that the long-term effects are accurately studied. Failure to adequately research reduced risk product may lead to the devastating economical effects of increased pest pressures.

OBJECTIVES

The objectives of the second year Walnut PMA is to continue to focus on reduced risk techniques with an emphasis on standardizing the treatments statewide. By building from the positive responses from the first year, we will continue to showcase economic pest control and to push forward into developing monitoring techniques for other pests.

Objective 1: Continue to build upon the Walnut Pest Management Alliance Team for implementation of reduced-risk strategies.

Objective 2: Demonstrate IPM strategies to control codling moth, *Cydia pomonella*.

Objective 3: Demonstrate IPM strategies to control blight, *Xanthomonas campestris*.

Objective 4: Demonstrate the impact of a replanted cover crop, a naturally reseeding cover crop, and native vegetation.

PROCEDURES

Objective 1

The Walnut PMA Management Team is the drive behind the Walnut PMA. The Management Team is responsible for directing and implementing reduced risk strategies. The Team incorporates many players into the program and seeks new ideas constantly. By meeting throughout the year to plan, coordinate, and share new ideas, the Management Team is able to work effectively and efficiently to ensure that the PMA gathers the most reliable and accurate data as possible.

Objective 2

Six early cultivar orchards were chosen ranging from Fresno to Tehama County. All orchards were under 35 feet in height. Five treatments consisted of: Isomate C+ alone, Isomate C+ and *Trichogramma planteri*, Isomate C+ and Lorsban or Confirm, the Grower Standard, and the untreated control. Treatments were approximately five acres with the exception of the untreated control that was approximately one acre. Isomate C+ was applied once by hand shortly after biofix at a rate of 400 per acre. Lorsban or Confirm was applied during the 1A or 2A flight or as deemed necessary by the farm advisor. *T. planteri* was aerially applied once per week for four weeks during the second generation and once per week for four weeks during third generation at a rate of 200,000 per acre. The grower standard consisted of the growers normal farming practices which normally includes organophosphate and pyrethroid use. Each orchard was monitored weekly from biofix to harvest and the liner changed as necessary. Trece® Delta Traps were used. Each treatment contained two delta traps, one hung low and one hung high in the canopy in the center of each treatment. In each of the pheromone treatments, the low trap contained the Trece® L2 lure, and the high trap contained the Trece® MegaLure. The grower standard and the untreated treatments were monitored with the Trece® L2 lure positioned low and high. The pheromone lures were changed according to protocol. Five trees were selected at random in each treatment and monitored throughout the season. The overwintering generation was monitored by nut drop, subsequent generations were monitored by canopy count, and the final evaluation occurred with a harvest sample.

Objective 3

Twenty-three (18 in San Joaquin County) were surveyed during the winter of 1999-2000 by collecting dormant walnut buds. Bioassays of these buds were conducted for the presence of walnut blight bacteria at Dr. Steve Lindow's laboratory at University of California, Berkeley for the percent of buds containing walnut blight bacteria and the amount of bacteria colony forming units (CFU) in the buds. The University of California Farm Advisors used this information to

advise their cooperating growers of the “blight risk” in their orchards and recommended treatment strategies based on the bioassays.

Five University of California Farm Advisors conducted uniform efficacy trials to evaluate a reduced risk approach to controlling walnut blight. The reduced risk treatment was an eradicant spray containing copper and Manex (where registered) plus the wetting agent Break-thru and was applied only once at bud break.

The treatment timings were as follows: bud break only, bud break plus grower standard, grower standard, and untreated.

The materials used were 0.5% Break-thru by volume with the bud break spray, 8 pounds of fixed copper/acre with each grower standard spray plus 58 oz. Manex / acre (where registered) at 100 gallons per acre. Break-thru is a silicon wetting agent used to help carry the copper/Manex into the buds. An orchard air blast sprayer applied materials at bud-break and/or various other times during the spring.

Objective 4

Cover crops were planted 2 years ago at two locations in Yuba County in 1998. One site, D-10, was replanted in December 1999 to augment reseeding after a herbicide application prevented some of the planted species from reseeding. The second site, Bear River, was allowed to reseed. Sampling of plant species present in the PMA and grower standard was conducted using 4 transects in each plot with 10 quadrats per transect. Each quadrat was a nested frequency quadrat with dimensions of 0.25 m by 0.25 m and 0.5 m by 0.5 m plot. Bear River was mowed prior to sampling so no comparisons are attempted for that site. Data presented are for a walnut orchard on D-10.

RESULTS

Objective 1. Continue to build upon the Walnut Pest Management Alliance Team for implementation of reduced-risk strategies.

The Walnut Pest Management Alliance Team has been proactive in implementing reduced risk practices and keeping the information moving from Farm Advisors, to field scouts, and to growers. Continuing to publicize reduced risk practices is the foundation to which reduced risk practices will become more widely used. The PMA Management Team continues to drive the implementation and research required to implement this new practice.

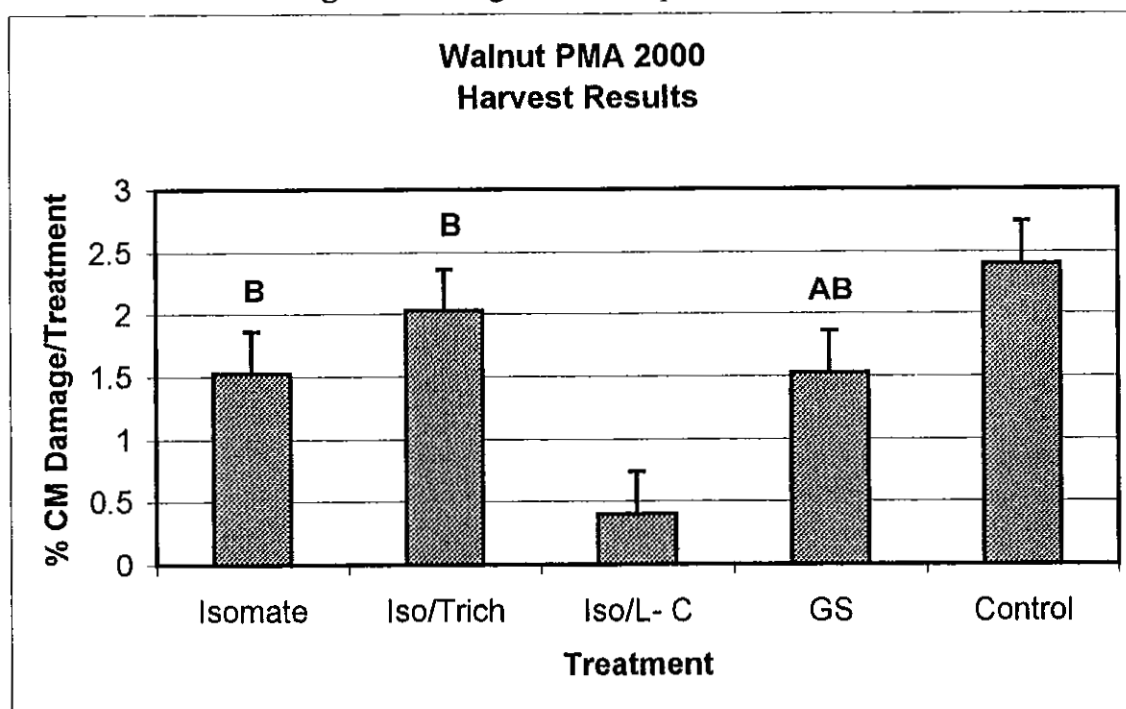
Objective 2. Demonstrate IPM strategies to control codling moth, *Cydia pomonella*.

Nut drop and canopy counts are tools to aid in determining damage and levels after each respective generation. The damage at harvest is the way to determine efficacy of each treatment. Two orchards were not used in order to determine these figures. Results are figured by how well each treatment controlled damage. In Yuba County, the grower standard treatment was not calculated because this orchard did not treat the grower standard. Table 2.1 shows the level of control for each orchard and each treatment. Graph 2.1 depicts the percent damage at harvest per treatment.

Table 2.1. Level of control in each orchard and each treatment in the Walnut PMA 2000.

	Isomate C+	Isomate C+ / Trichogramma	Isomate C+/ Lorsban	Grower Standard	Control
SJ-C	0.14	0.2	0	0.03	1
Yuba	0.85	1.75	0.11	-	1
Butte	0.73	0.34	0.06	0.23	1
Tehama	0.81	0.38	0.06	0.25	1
Average	0.63	0.67	0.06	0.17	
Std. Dev.	0.29	0.63	0.04	0.01	

Chart 2.1. Percent codling moth damage at harvest per treatment in the Walnut PMA 2000.



Objective 3: Demonstrate IPM strategies to control blight, *Xanthomonas campestris*.

A summary of the results from the bioassays can be in Table 3.1. The lack of rainfall this spring resulted in very little walnut blight. Consequently, none of the survey orchards had enough walnut blight to validate this method of predicting the amount of walnut blight in the orchard. This predictive model will have to continue for several years to fully measure its reliability and impact.

Table 3.1. Bioassay results from dormant walnut buds Walnut PMA 2000.

County	Average Log CFU/Bud	% Buds Infected	"Blight Risk"
SJ-1	2.33	58	Mod. High
SJ-2	0.67	22	Low
SJ-3	2.55	64	High
SJ-4	2.85	74	High
SJ-5	1.9	48	Moderate
SJ-6	0.084	3	Very Low
SJ-7	2.07	53	Mod. High
SJ-8	2.08	55	Mod. High
SJ-9	0.33	10	Very Low
SJ-10	1.75	47	Moderate
SJ-11	2.65	62	Mod. High
SJ-12	0.76	23	Low
SJ-13	1.22	47	Low
SJ-14	0.6	20	Low
SJ-15	0.47	13	Very Low
SJ-16	2.44	63	High
SJ-17	4.19	92	Very High
SJ-18	2.52	69	High
Butte	3.69	100	Very High
Tulare-D	2.49	60	High
Tulare-W	0.81	21	Low
Tulare	3.9	98	Very High
Fresno-KAC	3.23	100	Very High
Fresno-C	0.1	3	Very Low
Yuba	1.34	34	Moderate

The results from the reduced risk materials trial can be seen in Table 3.2. The values are expressed in percent walnut blight. With very little walnut blight present at any location no conclusions can be drawn from this years trial. However, the one application bud break spray did reduce the amount of walnut blight in the orchard as compared to the untreated. Also, the single application treatment had nearly the same level of walnut blight as was found in the grower standard treatment, which had multiple applications. To adequately evaluate this treatment more severe walnut blight conditions need to occur.

Table 3.2. Percent walnut blight Walnut PMA 2000.

County	Bud Break Only	Bud Break + Grower Standard	Grower Standard	Untreated
Butte	1.6	1.05	0.85	2.35
Yuba	2.55	3.75	NA	4.8
Fresno	0	0	0	0
San Joaquin	0.25	0.1	1.45	N/A
Tehama	0.18	0.33	0.62	2.32
Average	0.92	1.05	.73	2.37

Objective 4. Demonstrate the impact of a replanted cover crop, a naturally reseeding cover crop, and native vegetation.

The species present at the site are summarized in Table 4.1 below.

Table 4.1. Plant species present at two PMA walnut orchards.

D-10	Plant Category	Bear River	Plant Category
Clover sp	F	Blando brome	F
Medic	F	Zorro fescue	F
Pink nitro	F	Burr clover	F
Crimson clover	F	California brome	F
White subclover	F	Clover sp	F
Blando brome	F	Yellow subclover	F
Vetch sp	F	White subclover	F
Annual bluegrass	WW	Chickweed sp	WW
Pineappleweed	WW	Wild oat	WW
brassbuttons	WW	Prickly lettuce	WW
Annual ryegrass	WW	Sheperdspurse	WW
Chickweed sp	WW	Annual bluegrass	WW
Henbit	WW	Common mallow	WW
Speedwell	WW	Filaree sp	WW
Annual brome sp	WW	Burr buttercup	SW
Common mallow	WW	Foxtail barley	SW
Sheperdspurse	WW	Thistle (<i>Cirsium</i> sp)	SW
Filaree sp	WW	Field bindweed	SW
Common groundsel	WW	Prostrate knotweed	SW
Burr buttercup	SW		
Annual crabgrass	SW		
Thistle (<i>Cirsium</i> sp)	SW		
Prostrate spurge	SW		
Foxtail barley	SW		
Scarlet pimpernel	SW		
Gallium sp	SW		
Common purslane	SW		

Plant category: F = forage, WW= fall or winter weed, SW = spring or summer weed.

Winter weeds were decreased in the cover crop plot versus the resident vegetation plot. Summer weeds were not different between plots. Table 4.2 shows the results of the fall and winter weed occurrences for cover crops. The mowing of the cover crop at Bear River may have allowed additional growth of weeds

Table 4.2. Fall and winter weed occurrences for cover crop versus no cover crop plots at D-10.

Treatment	Fall/Winter Occurrence (%)	Spring/Summer Occurrence (%)
Cover crop	9 a ¹	11 a ²
No cover crop	29 b	22 a

¹P=0.015

²P=0.22

DISCUSSION

The Walnut PMA is not solely for demonstration but has now shifted its focus to a statewide reduced risk research project. Attempting to include all of the pests that commercial walnut growers face is a large task. The codling moth control component was successful. To a large extent, codling moth was controlled using pheromone. As demand for the pheromone product increases and the supply increase, then the product may become more economically feasible for growers. All treatment blocks were under 2.5% damage at harvest. Whereas the treatment of Isomate C+ and Lorsban showed the most control, the Isomate C+ alone and Isomate + Trichogramma were encouraging for implementing reduced risk strategies. The blight project had very little blight to evaluate this year. The lack of rainfall this spring resulted in very little walnut blight, making evaluations difficult. We will be asking cooperating growers to continue working with us on evaluating this treatment in 2001.

WALNUT PEST MANAGEMENT ALLIANCE 2000 - YEAR 2 UPDATE

Management Team: C. Pickel, W. Bentley, T. Prichard, W. H. Olson, R. Buchner, J. Grant, T. Prather, M. Johnson, and B. Elliott

Cooperating Farm Advisors: J. K. Hasey, W. H. Olson, R. P. Buchner, W. H. Krueger and M. Freeman

Regional Field Scouts: N. Darby, M. Goff, and B. Ribeiro

Cooperating Researchers: Steve Lindow, Steve Welter, and Nick Mills

ABSTRACT

The Walnut Pest Management Alliance (PMA) was established with the funding provided by California Department of Pesticide Regulation (CDPR) in 1998 to develop a statewide broad-based demonstration and implementation project designed to encourage adoption of reduced-risk pest management programs in commercial walnuts. The PMA is a cooperative group effort that includes the University of California research and extension, walnut growers and industry, Biologically Integrated Orchard Systems (BIOS), and pest control advisors. In the second year of the Walnut PMA, the program continues to promote reduced-risk products and to improve communication and cooperation among the groups involved. The Walnut PMA projects evaluates reduced risk strategies for codling moth, *Cydia pomonella*, blight, *Xanthomonas campestris*, cover crop, and assesses the economics of implementing a reduced risk program. These efforts attempt to control the economic damage of pests by implementing reduced risk practices. The Walnut PMA codling moth research project included six early cultivar walnut orchards ranging from Fresno to Tehama county. Blight was evaluated in the dormant season and again in late May to determine damage levels. The cover crops were assessed in the spring to determine reseeding and survival. The economics show the adoption cost of these programs. Growers have not readily adopted these reduced-risk alternatives because these practices are perceived as high risk and more expensive than using conventional broad-spectrum insecticides. Reduced-risk programs require multiple years of implementation in order to gain the confidence of commercial walnut growers. The performance of reduced risk techniques requires a commitment and teamwork so that the long-term effects are accurately studied. Failure to adequately research reduced risk product may lead to the devastating economical effects of increased pest pressures.

OBJECTIVES

The objectives of the second year Walnut PMA is to continue to focus on reduced risk techniques with an emphasis on standardizing the treatments statewide. By building from the positive responses from the first year, we will continue to showcase economic pest control and to push forward into developing monitoring techniques for other pests.

Objective 1: Continue to build upon the Walnut Pest Management Alliance Team for implementation of reduced-risk strategies.

APPENDIX C

REGIONAL MEETING AGENDAS FROM JANUARY 13, 14, AND 21, 2000.

**Sacramento Valley Walnut PMA Agenda
January 13, 2000
9:30 a.m. Yuba City Farm Advisor Office
142-A Garden Hwy
530 822-7515**

9:30 AM Introductions – Carolyn Pickel

9:45 AM Review Walnut PMA Results for 1999

**Codling Moth – Carolyn Pickel
Blight – Bill Olson and Rich Buchner
Cover Crops – Tim Prather**

11:00 AM Work Plan for 2000

**Codling Moth – Carolyn Pickel
Blight – Bill Olson
Irrigation – Terry Prichard**

Lunch Provided

Lower San Joaquin Walnut PMA Agenda

January 14, 2000 – 9:30 a.m.
UC Cooperative Extension San Joaquin County
420 S. Wilson Way, Stockton, CA
(209) 468-2085

- | | |
|----------|---|
| 9:30 AM | Introductions – Carolyn Pickel |
| 9:45 AM | Review Walnut PMA Results for 1999 |
| | Codling Moth & Blight – Carolyn Pickel |
| | Cover Crops & Irrigation – Terry Prichard |
| 11:00 AM | Work Plan for 2000 |
| | Codling Moth & Blight – Carolyn Pickel |
| | Cover Crops & Irrigation – Terry Prichard |
| 12:00 PM | Lunch Provided |

SAN JOAQUIN VALLEY WALNUT PMA MEETING
January 21, 2000

Large Conference Room
Kearney Agricultural Center
9240 S. Riverbend Avenue, Parlier, CA 93648

AGENDA

9:30 a.m. Introductions Walt Bentley

9:45 a.m. Review Walnut PMA Results for 1999

Codling moth.....Carolyn Pickel
and Walt Bentley

Blight.....Bill Olson and Rich Buchner

Cover crops Tim Prather

11:00 a.m. Work Plan for 2000

Codling moth.....Carolyn Pickel
and Walt Bentley

Blight.....Bill Olson

Irrigation..... Terry Prichard

LunchHosted by the Walnut Marketing Board

APPENDIX D

**ARTICLE FROM *DIAMOND OF CALIFORNIA WALNUT NEWS AND REVIEW*,
JANUARY 2000, "GROWERS TAKE STEWARDSHIP ROLES SERIOUSLY".**

this potential, which varies from person to person; by some generous estimates, nut allergies may affect 1.1 percent of the population. Because someone allergic to pistachios may not be to walnuts, it is imperative that a bag labeled "walnuts" contains nothing but.

In 1994, responding to a request from General Mills, Diamond adopted

a comprehensive policy and protocols to prevent the accidental mixing of nuts. The programs, which include tagging bins, scrupulously cleaning the lines and keeping extensive records, "are consistent with the requirements of the U.S. Food and Drug Administration, which since 1996 has urged manufacturers to take all necessary steps to eliminate the

accidental inclusion of unidentified foods," according to Lindsay.

All work-in-process (WIP), or nuts undergoing various phases of processing in the plant, is held in metal bins, each of which carries its own specific bar-code "license plate." Another bar code is printed on the production tags, so Diamond knows what is in each bin at any given time. This is a unique feature that allows Diamond to track the cleaning of bins through its computer inventory system. Not only are they vacuumed extensively, they're also steam-washed and rinsed.

Because Diamond's packaging lines convey other types of nuts, quality-control personnel carefully check equipment when products are changed over. "QC has a checklist and has to sign off on each piece identified. The equipment is not released till it is cleaned and passes inspection with a flashlight," said HACCP Manager Logan.

Growers Aid Effort

With the 1998 harvest, the company adopted a truck pit inspection program for every incoming truck, virtually eliminating all "other" nuts from incoming loads.

Diamond's grower-owners have been doing their part in the field by checking and cleaning shakers and other harvesting equipment of other nuts before allowing it into the walnut orchard, and inspecting the huller operation before their crop arrives to ensure no other types of nuts are present in elevator boots, under bucket elevators and in hopper corners. Truck elevators, trailer-hopper corners and slide-gate mechanisms are inspected, too, to ensure the absence of almonds or pistachios.

Historically, there have been instances of pistachios winding up in a few truckloads, which required meticulous and expensive hand-sorting—but not the past couple of years. Said Lindsay, "We didn't find any problems at all this year, which is very encouraging." ♦

Growers Take Stewardship Role Seriously

Safeguarding the environment—as well as the nation's food supply—is something farmers take seriously in their role as stewards of the land. Diamond's own grower-members have always had a stake in environment-safe farming practices. Many are longtime practitioners of IPM (integrated pest management), a comprehensive approach to environmentally sound pest control. Several also

anticipated last year in the start-up of the Walnut Pest Management Alliance, a unique statewide partnership of growers, researchers, regulators and others in the walnut industry.

According to Carolyn Pickel, UC Cooperative Extension area IPM advisor, the effort finished up an extremely promising first year and was in the process of summarizing its data as it entered 2000. The PMA is proving a continual learning experience as growers and researchers work with a new pheromone/paraffin formulation for codling moth control, different cover crop mixes and other program aspects. In the coming year, PMA demonstration plots will be redesigned and reduced in number from a dozen to seven. Only trees of the Vina and Ashley varieties will be included and only if they are under 35 feet tall ("pheromone mating disruption is a numbers game that will work better in a smaller tree canopy," Pickel explained). Unlike last year, when participants chose their treatments, all will use the same regimen.

"We're encouraged by what we've seen so far and have learned a lot on how to better standardize and conduct this project," she said.

A similar, localized program is the San Joaquin County BIOS (Biologically Integrated Orchard Systems) Project that also got under way last year. It is a project of the Community Alliance with Family Farmers (CAFF), which provides on-site technical assistance and coordination, and is funded by a grant from UC's Sustainable Agriculture Research and Education Program (SAREP).



APPENDIX E

**ARTICLE FROM *DIAMOND WALNUT NEWS*, APRIL 2000, "WALNUT PMA
NARROWS FOCUS".**

April, 2000

Walnut PMA Narrows Its Focus

Measuring program's success was difficult in just one year.

A reduction in funding has prompted the year-old Walnut Pest Management Alliance to narrow its focus—and, it is hoped, to arrive at firmer conclusions more quickly, according to Carolyn Pickel, the area IPM advisor for the Sacramento Valley who heads up the alliance.

The number of test plots has been reduced from the original dozen to seven, and all participants are following the same protocols. Several Diamond members participated in the project's inaugural year and will continue to participate in one or more aspects of what Pickel hopes will be a three-to-five-year study.

In its first year, growers experimented with 22 different practices, singly and in combination, "so it was difficult to come up with any sort of consensus," she explained. This year, all growers will apply the same treatments and compare them to small "checks" or untreated plots about a quarter-acre in size, "so we can draw some stronger conclusions."

The PMA was established in 1998 with the state's Department of Pesticide Regulation. Its goal, according to Pickel and the other team members, has been to "develop a statewide, broad-based demonstration and implementation project...to encourage adoption of a reduced-risk pest management program" among commercial walnut growers. Another goal is to facilitate communication and cooperation among growers and the various groups involved, which in addition to the DPR include UC Cooperative Extension and the BIOS

(Biologically Integrated Orchard Systems) Project.

Measuring program success was difficult in just one year, the team concluded in its year-end report. "Some orchards had remarkable success

...whereas other orchards should be reevaluated in order to determine if a reduced-risk program can be beneficial at this time....Future research will include a more comprehensive treatment plan and structured monitoring program for pests in order to better understand the role reduced-risk pesticides have on commercial walnuts."

One area of interest in last year's program was a paraffin/pheromone combination that was sprayed into

trees for codling moth control. Since then, however, the product was sold by the company that developed it and its fate is uncertain, although Pickel is hopeful that work on the formulation will continue. Until it is perfected, she said, the PMA will go back to hand-held dispensers of mating-disruption pheromones. The PMA is very fortunate to have the assistance of Dr. Steve Welter of UC-Berkeley this year, whose research into mating-disruption techniques will be used in the pest-management plots.

Several field days will be held this summer to update walnut growers on the PMA; watch upcoming newsletters and other publications for dates and locations. The PMA's first-year findings are outlined in *Walnut Research Reports 1999*, available from the Walnut Marketing Board (see page 7). ♦

WALNUT PMA OBJECTIVES

1.
Develop Walnut Pest Management Alliance Team for implementation of reduced-risk strategies
2.
Demonstrate IPM strategies to control codling moth
3.
Demonstrate walnut blight reduced-risk pest management strategies
4.
Demonstrate orchard floor management and irrigation strategies for demonstration sites

NEW UC AG PUBLICATIONS CATALOG AVAILABLE

Everything from apples to zucchini is covered in the University of California Division of Agriculture and Natural Resources (ANR) 2000/01 catalog. The booklet lists an extensive array of publications, posters, videos and slide sets. The catalog and many other publications are available at county offices of UC Cooperative Extension or online at <http://anrcatalog.ucdavis.edu>, or write to ANR Communications, University of California, 6701 San Pablo Ave., Oakland, CA 94608-1239, call toll-free 1-800-994-8849, or E-mail danrcs@ucdavis.edu.

APPENDIX F

**ARTICLE FROM CALIFORNIA FARM BUREAU'S *AG ALERT*, FEBRUARY 9, 2000,
"WALNUT GROWERS REDUCING RISKS IN THEIR ORCHARDS".**

CALIFORNIA

TREES & VINES[®]

A SPECIAL GROWERS SECTION OF AG ALERT[®]



Photo/Robyn Rulger Evans

UC farm advisor Bill Olson of Butte County discusses effective codling moth control programs for walnuts.



UC farm advisor Bill Olson of Butte County discusses effective codling moth control programs for walnuts.

Walnut growers reducing risks in their orchards

By Robyn Rutger Evans
Managing Editor

Facing the potential loss of conventional pesticides, some walnut growers are using "reduced risk" programs in an effort to combat codling moths that attack their orchards.

Codling moths, which are one of the worst pest problems in walnuts as well as apples and pears, lay eggs in orchards. The worm-like larvae that emerge eat the nuts and fruit, causing significant yield losses for farmers.

Bill Olson, University of California farm advisor in Butte County, discussed the results of the Pest Management Alliance trial during a UC Cooperative Extension meeting held at Bremner Farms near Chico. The PMA is a California Department of Pesticide Regulation program devoted to reducing pesticide risks. The Sacramento-based Walnut Marketing Board is one of 17 participants in the 1999 PMA who are trying to develop reduced-risk pest management practices.

"The reason we're doing this is due to the FQPA," Olson said, referring to the 1996 Food Quality Protection Act that was unanimously approved by

Congress. The legislation, which mandates that the U.S. Environmental Protection Agency reassess the human health risk of more than 9,000 chemicals, is restricting the use of many agricultural chemicals. Due to the loss or potential loss of some pesticides, the agricultural industry is searching for alternatives to combat crop yield-reducing insects and diseases.

In the PMA trial, researchers are studying the use of sex pheromones for mating disruption; natural predators such as *Trichogramma* wasps, which lay their eggs in codling moth larvae; *Bacillus thuringiensis*, a bacteria that produces a toxin that kills the larvae of various insect pests; and two insect growth regulators, Confirm and Dimilin.

Research funding in the amount of \$150,000 is being used to develop reduced-risk strategies for walnut production, Dave Ramos, research director of the Walnut Marketing Board, said.

Richard Price, Butte County agricultural commissioner, said developing reduced risk programs is important because of increasing regulatory restrictions on pesticides. "The writing on the wall says that people who use low risk management are going

to be ahead of the game," he said.

Importing parasitoids for codling moth management in walnuts was discussed by UC Berkeley research scientist Nick Mills. The codling moth—which is native to Central Asia—has very few natural enemies in California, and Mills hopes to change that. He collected three parasitoid species from Central Asia "where Russia meets China" and released them in California. The parasitoids—all of which are parasitic wasps—attack either the larval stage or the cocoon stage of the codling moth. In Central Asia, "these parasitoids are very important for keeping the codling moth populations down," and farmers in the region do not use insecticides to control them.

Russ Stocker of Arena Pest Management gave a presentation on aerial application of *Trichogramma* wasp eggs. The eggs are released at a rate of about 500,000 eggs per minute from a beneficial insect release unit that is mounted on an airplane that flies about 135 miles per hour over an orchard. The tiny eggs are mixed with an adhesive so they will stick on the leaves in the canopy of each walnut tree. Once the eggs hatch and the wasps mature, the female

See WALNUTS, Page 18

Walnuts

Continued from Page 9

wasps lay their eggs in the codling moth larvae, thereby killing them. Stocker is now trying to develop a beneficial insect release unit that can be attached to a ground rig as an alternative application method.

Several new codling moth traps were displayed by Carolyn Pickel, UC Integrated Pest Management area advisor. The traps are part of a pheromone mating disruption strategy. Growers use the traps to monitor the infestation level of codling moths in an orchard in order to determine the appropriate time to treat.

Molly Espley, Biologically Integrated Orchard Systems program assistant, discussed BIOS involvement in the walnut PMA. Walnut growers who participate in the BIOS program are trying to reduce their dependence on chemical pesticides and synthetic fertilizers. "We feel that the PMA takes the BIOS demonstration project to the next level," she said.

The effect of reduced risk programs on secondary pests was addressed by Bill Krueger, Glenn County farm advisor. Treating primary pests can also

kill beneficial insects that prey on secondary pests; thus, the population of the secondary pests can increase. Two secondary pests of concern in walnut orchards are walnut aphids and web-spinning mites, Krueger said. "One goal of these reduced risk strategies is using materials that are less disruptive and preserve beneficial insects so we don't have to treat for secondary pests," he said.

Conventional chemicals such as pyrethroid insecticide tend to be cheaper than the softer alternatives. Butte County walnut grower Jim Bremner uses pyrethroid for the first generation of codling moth larvae, but he will not use it on subsequent generations because "it is almost a certainty that it will flare up the mites," he said. Therefore, he applies Bt twice per codling moth gen-

eration. The reason is that each codling moth flight lasts about 25 days, but a single Bt application is only effective for a few days. Bremner has been applying Bt for the past four years and has had "good results." He is also experimenting with Confirm and has had "reasonable results" with this insect growth regulator. Bremner is sup-

portive of the use of reduced risk products. "If it makes dollars and sense, and it controls codling moths, sure we're going to do it," he said.

In terms of growers adopting reduced risk methods, "As bugs in the system get worked out, there's going to be buy-in," Bob Elliot of the Department of Pesticide Regulation said.



Photo/Robyn Ridger Evans

Butte County Agricultural Commissioner Richard Price discusses importance of reduced-risk pest control programs to walnut growers at a meeting near Chico.



**Your Valley Source for
Vineyard and
Orchard Equipment**

APPENDIX G

**ARTICLE FROM CALIFORNIA FARM BUREAU'S *AG ALERT*, SEPTEMBER 13, 2000,
"IPM PROGRAM FOR CODLING MOTH CONTROL IS EXPANDED".**

IPM program for codling moth control is expanded

By Kate Campbell
Assistant Editor

Codling moth is a stubborn pest for walnut growers, who, in recent years, have had to apply increasing amounts of pesticides in their orchards to achieve control. But with the efforts that are well underway to help growers battle this damaging pest, the future promises control with a reduced amount of chemicals.

"Control of codling moth in walnuts is as close as three to five years away," Carolyn Pickel, University of California integrated pest management advisor for the Sacramento Valley and the project coordinator, said. "It's 80 percent under control in pears. We know IPM practices work in pears. We're convinced it will work in walnuts."

To that end, the Walnut Pest Management Alliance has been stepping up efforts to refine multi-tactic, reduced-risk pesticide practices to control codling moth. The reduced-risk demonstration project now is in its second year of field testing across California.

Members of the alliance include growers, the Walnut Marketing Board, the state Department of Pesticide Regulation, the UC Statewide IPM Project, Biologically Integrated Orchard Systems, UC researchers, UC Cooperative Extension farm advisors, pesticide applicators and insectaries.

At stake is California's \$229 million walnut industry, a crop ranked 20th on the state's list of most valuable crops. In 1998, walnuts had an export value of \$150.5 million, making it the state's 10th most valuable agricultural export.

The California Department of Food and

Agriculture reports that in 1998 there were about 200,000 acres of walnuts growing in the state. Of the many varieties grown, about half are susceptible to codling moth.

The first year's program offered promising results. Of the 12 orchard sites used in the research and demonstration project, some had remarkable success in shrinking moth populations using reduced-risk techniques. Others will have to be reevaluated for integration of conventional practices. A few orchards showed signs of building populations.

Starting March 1, there were seven test sites in California walnut orchards. Alliance participants began using carefully refined, multi-level treatment programs to identify the most effective IPM approaches. In this second phase of the project, the smaller number of test sites make management and monitoring more precise.

Walnut orchards in Fresno, Tulare, San Joaquin, Contra Costa, Butte, Yuba and Tehama counties are being used, with growers participating fully in development and execution of the study.

Three regional implementation teams coordinate interaction and planning between alliance participants, with Pickel providing overall guidance for the project.

Codling moth larvae, which attack apples, pears and apricots in addition to walnuts, tunnel into host fruit and nuts to eat the seeds and inner tissue. This tunneling also creates openings for other pests and disease organisms to do damage. The greatest damage is caused spring through summer.

Codling moth, *Cydia pomonella*, was imported from Europe sometime in the early 1800s, but its natural enemies did

age each year. It is probably one of the most thoroughly studied pests, but through the years control has eluded scientists and farmers alike.

The codling moth overwinters in the pupal or cocoon stage. The pupae can be found in tree crotches, branches, weeds, grass, litter and other protected places near the tree. The adult moth emerges from the cocoon in the spring about the time the trees are in bloom. The moth soon mates and lays eggs.

The adults have gray to brownish forewings with gray crosslines and a characteristic coppery-brown spot near the tip of each wing. The hind wings are pale with fringed borders. The wing span is about 3/4 inch. Adults are not strong fliers and do not travel great distances.

No single method for controlling this damaging pest has proven effective. Nature provides a high mortality rate at various stages of development, but this level of control still leaves a population above what can be tolerated by growers.

Only depending on one type of control—be it cultural, biological or chemical—has not proven to be as effective as an integrated pest control program where several approaches are used in concert.

"My orchard isn't one of the demonstration sites, but I have been following the project very closely," Winters walnut grower Craig McNamara said. He is an alternate to the walnut commission's board of directors for District I.

"We're doing most of the things being tried in the project," he said. "I don't expect to fully eliminate the codling moth from my orchards, but I expect to reduce the amount of damage and the use of pesticides at the same time."

McNamara said the costs of IPM techniques are manageable when put in the

One of the problems walnut growers face, Pickel said, is the height and size of their trees' canopies. Hanging ropes to attract the moth with pheromones, spraying and collecting samples all must be done at considerable height, which is expensive and time consuming.

"In orchards where populations are low, growers have managed codling moth successfully using mating disruption techniques and a supplemental pesticide like Confirm," Pickel explained. "In high population orchards, the first year we're using Isomate C+ and an organophosphate insecticide application of either Guthion, Lorsban or Imidan."

The idea, Pickel said, is to systematically bring populations down over several years using IPM management techniques appropriate to the growing region and growers' standard practice.

One thing that helps in control is clean cultural practices. Keep lumber and debris away from trees, eliminating overwintering places. Codling moths have some natural predators. Birds, especially woodpeckers, nuthatches and chickadees, are heavy feeders of exposed larvae and pupae.

Ants prey upon the newly hatched larvae and should not be removed unless the ants are tending aphids. Some beetles and fungal diseases will attack both the larvae and pupae. A species of braconid wasp, *Ascogaster quadridentata*, is one of the major parasites of the codling moth. Some species of *Trichogramma* wasp also parasitize the eggs. Planting cover crops below the trees can provide refuge for predators and parasites. White clover, sweet alyssum, thyme, wooly yarrow and wildflowers provide good cover and encourage the buildup of predators.

"Codling moth is probably one of the most studied insects," Pickel said. "Yet,

testing across California.

Members of the alliance include growers, the Walnut Marketing Board, the state Department of Pesticide Regulation, the UC Statewide IPM Project, Biologically Integrated Orchard Systems, UC researchers, UC Cooperative Extension farm advisors, pesticide applicators and insectaries.

At stake is California's \$229 million walnut industry, a crop ranked 20th on the state's list of most valuable crops. In 1998, walnuts had an export value of \$150.5 million, making it the state's 10th most valuable agricultural export.

The California Department of Food and

Tehama counties are being used, with growers participating fully in development and execution of the study.

Three regional implementation teams coordinate interaction and planning between alliance participants, with Pickel providing overall guidance for the project.

Codling moth larvae, which attack apples, pears and apricots in addition to walnuts, tunnel into host fruit and nuts to eat the seeds and inner tissue. This tunneling also creates openings for other pests and disease organisms to do damage. The greatest damage is caused spring through summer.

Codling moth, *Cydia pomonella*, was imported from Europe sometime in the early 1800s, but its natural enemies did not follow. Since then the pest has spread to orchards throughout the United States, causing many millions of dollars in dam-

Only depending on one type of control—be it cultural, biological or chemical—has not proven to be as effective as an integrated pest control program where several approaches are used in concert.

"My orchard isn't one of the demonstration sites, but I have been following the project very closely," Winters walnut grower Craig McNamara said. He is an alternate to the walnut commission's board of directors for District I.

"We're doing most of the things being tried in the project," he said. "I don't expect to fully eliminate the codling moth from my orchards, but I expect to reduce the amount of damage and the use of pesticides at the same time."

McNamara said the costs of IPM techniques are manageable when put in the perspective of future restrictions on the use of pesticides and consumer preference for organic produce.

some natural predators. Birds, especially woodpeckers, nuthatches and chickadees, are heavy feeders of eggs and larvae and pupae.

Ants prey upon the newly hatched larvae and should not be removed unless the ants are tending aphids. Some beetles and fungal diseases will attack both the larvae and pupae. A species of braconid wasp, *Ascogaster quadridentata*, is one of the major parasites of the codling moth. Some species of *Trichogramma* wasp also parasitize the eggs. Planting cover crops below the trees can provide refuge for predators and parasites. White clover, sweet alyssum, thyme, woolly yarrow and wildflowers provide good cover and encourage the buildup of predators.

"Codling moth is probably one of the most studied insects," Pickel said. "Yet, we still haven't controlled it in walnuts. We're going to be using pheromone treatments in conjunction with other management tools."

Female codling moths release a substance known as a pheromone. Pickel said there is a misconception that pheromones attract males.

"It actually bugs or confuses them," she said. "Whether they are attracted or repelled, we don't know. There's still a lot of research to do. We do know it disrupts the mating cycle. The approach works in pears and we're convinced it will work in walnuts."

Using a multi-tactic approach, including mating disruption techniques, to reduce and manage codling moth is more expensive than spraying alone, but Pickel said, "As more growers use IPM approaches we will achieve economies of scale and costs will decrease. And with the possible loss of some organophosphates, this may not only be the best practice, it may be the only one."

For more information on IPM practices and control of codling moth, growers should contact their local UCCE office or farm advisor.

RAIN FOR RENT



FROST PROTECTION

Let Rain for Rent help you with short-term, seasonal pumping or piping needs and avoid the high cost of a permanent installation. Think of Rain for Rent for pumps and pipe.

An irrigation system can assist with:

- Frost control
- Bud break timing
- Canopy and ground temperature controls
- Climate control

For more information call

1-800-742-7246

P.O. Box 2248

Bakersfield, CA 93303

www.rainforrent.com



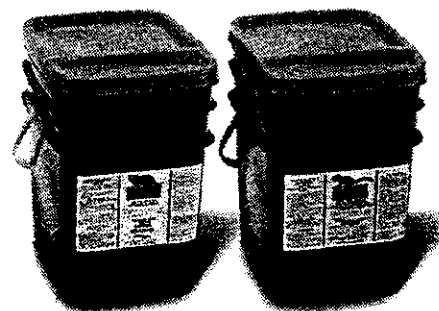
For Ground Squirrel and Pocket Gopher Control

rozol®
RODENTICIDE

Rozol is made with
chlorophacinone, the most
active multiple-feed
anticoagulant available.

There's no need to
prebait, and it has
exceptional palatability.

Ground squirrel is a 24(c) registration.
Not available in all states.



Rozol is available in two convenient forms:

- Ground squirrel – paraffinized pellets
- Pocket gopher – grain bait

For more information, contact your distributor or:

LIPHATECH® (800) 558-1003
www.liphatech.com

APPENDIX H

**MEETING AGENDA FROM WALNUT PMA AND SAN JOAQUIN BIOS PROJECT
JOINT FIELD MEETING ON AUGUST 30, 2000.**

Walnut Pest Management Alliance and San Joaquin BIOS Project Statewide Field Meeting

Topics & Speakers:

Why Does the Walnut Board Support the Walnut PMA?
Dave Ramos, Walnut Marketing Board

DPR's Role in the Walnut PMA
Bob Elliott, Department of Pesticide Regulation

BIOS Participation in the Walnut PMA
Molly Johnson, Community Alliance With Family Farmers

San Joaquin BIOS Project Coordination with the Walnut PMA
Joe Grant, San Joaquin County Farm Advisor

An Overview of Alternative Codling Moth Control Methods
Walt Bentley, Entomology IPM Advisor, Kearney Ag Center

Trichogramma Releases: Successes and Limitations
Nick Mills, Biological Control Specialist, UC Berkeley

Mating Disruption in Walnuts: Successes and Limitations
Steve Welter, Entomologist, UC Berkeley

Monitoring Walnut Orchards for Pests and Beneficials
Jeannine Groh, San Joaquin Walnut BIOS Field Scout

Management Considerations When Using Alternative Codling Moth Control Methods
Carolyn Pickel, Area IPM Advisor, Sacramento Valley

Experiences Using Alternative Codling Moth Control Methods
Grower/Industry Panel

***Wednesday, August 30, 2000
9am Noon***

For more information, contact Molly Johnson, (530) 756-8518 ext. 30, or molly@caff.org

APPENDIX I

BIOS PROJECT GROWER QUESTIONNAIRE.

**9/30/00 EVALUATION SUMMARY --
Walnut PMA Field Day
Chiappe Farms, Farmington, Calif.
29 Evaluations**

The Walnut Pest Management Alliance would like to make these field days as informative and practical as possible. Please take a few moments to fill out this evaluation, so that we can use your input to help plan future events.

How did you hear about this event?

- 16 Farm Advisor
- 18 Print media
- 1 Internet
- 3 Co-worker/friend
- 1 other

Will the information provided today be useful in your own orchard?

- 24 Yes
- 11 Maybe
- 0 No

Which part of the field day was most useful?

- | | |
|---------------------|--|
| 6 Research findings | 1 New strategies |
| 3 Practical usage | 3 Info. about pests and predators/Monitoring |
| 5 All was useful | 1 Aerial application of <i>Trichogramma</i> |
| 1 BIOS results | 1 Codling moth |
| 2 Meeting people | 2 Data sheets |
| 5 Mating disruption | 1 Alternatives and costs |
| 3 Trap information | |

Which part of the field day was least useful?

- 4 Introduction
- 1 Graphs
- 3 Trap information

Was there enough time for discussion about the topics presented?

- 15 Strongly agree, level 1,
- 12 level 2
- 7 level 3
- 1 level 4
- 0 level 5 Strongly disagree

Was there enough hands-on participation?

- 12 Strongly agree, level 1,
- 17 level 2
- 9 level 3
- 3 level 4
- 2 level 5 Strongly disagree

Do you have suggestions for topics you would like to see covered at future field days?

Economics (analysis of conventional treatment vs. BIOS), chipping walnut brush, more harvest data, crown gall, have people monitor a portion of the orchard, manure and compost, future data, how to calculate degree days, fertility, cover crops, irrigation

ADDITIONAL COMMENTS (Feel free to write on back of this survey):

Talks were great and to the point

Challenge to industry to develop grower incentives to use "green" methods

More handouts